EMERGENCY DEPARTMENT UTILIZATION AMONG PEDIATRIC AND YOUNG ADULTS WITH INTELLECTUAL AND DEVELOPMENTAL DISABILITIES (2009-2014)

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DEDICATION

This dissertation is dedicated to Seth, Michelle, and Carl Mullen.

Through your daily love, your tenacity, and your fight for a better life I have been driven to this work. You have taught me to discover and then fight for what could be and not accept what is. Thank you!

Cody J. Mullen

EMERGENCY DEPARTMENT UTILIZATON AMONG PEDIATRIAC AND YOUNG ADULTS WITH INTELLECTUAL AND DEVELOPMENTAL DISABILITIES (2009-2014)

Introduction: The prevalence of those aged 3-25 with an intellectual and developmental disability (I/DD), has increased 17.1% from 1997 to 2008. This study focused on these I/DD: autism spectrum disorder (ASD), cerebral palsy, learning disabilities and spina bifida. Previous studies have found that individuals with an I/DD use health services and the emergency department (ED) more frequently, regardless of payer.

Methods: This dissertation will describe and define the characteristics of ED use among children and young adults with an I/DD. A repeated, cross-section of annual data of a national sample distributed by the Agency for Healthcare Research and Quality Healthcare Utilization Project National Emergency Department Sample will be analyzed from 2009-2014. This approach will document the primary clinical reason for ED use, the appropriateness of the need for a visit, and demographic, geographic, and temporal correlates for medical, injury, and psychiatric care visits in the ED. The appropriateness of need will be assessed by the New York University (NYU) Emergency Department Diagnosis Classification method for medical care visits. A logistic regression model will be specified for each visit type.

Results: The sample included 386,632 visits with an I/DD diagnosis. The NYU classification method found that 44.6% of all visits for ASD were classified as non-emergent yet the other three I/DD had a non-emergent visit rate ranging 25.9%-28.8%.

The ASD sub-sample was 51.8% of all visits for psychiatric care and 50.5% of all visits for injury care. All independent variables tested: admission on weekend, ED trauma level, age, sex, payer source, patient zip code income quarterlies, and patient rurality, were found to be statistically different for each model.

Conclusion: The findings indicate the need for development of interventions that are specific to reducing non-emergent ED utilization for children and young adults with a diagnosis of ASD and interventions developed for reduction of emergent ED care for the other I/DD's. In addition, unique interventions are needed to reduce the utilization of the ED for psychiatric care specifically for the ASD population and utilization of the ED for injury care for all I/DD diagnoses.

Cynthia Stone, DrPH, Chair

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LIST OF ABBREVIATIONS

AHRQ	Agency for Healthcare Research and Quality
ASD	Autism Spectrum Disorder
CHSCN	Child with Special Health Care Needs
CMS	Center for Medicare and Medicaid Services
CPT	Current Procedural Terminology
DD	Developmental Disabilities
ED	Emergency Department
HCUP	Healthcare Utilization Project
ICD	International Classification of Disease
I/DD	Intellectual and Developmental Disability
ID	Intellectual Disability
MEPS	Medical Expenditure Panel Survey
NEDS	National Emergency Department Sample
NIH	National Institute of Health
NYU	New York University
OR	Odds Ratio

Introduction

The prevalence of children and young adults aged three to 25, with an intellectual and developmental disability (I/DD), has increased 17.1% from 1997 to 2008 [1]. Examples of an I/DD include: autism spectrum disorder (ASD), cerebral palsy, learning disabilities and spina bifida [2]. Individuals with ASD have been the largest proportion in the increase in prevalence among I/DD, an increase of 50.0% in just eight years (2008 to 2014) [3-6]. Children and young adults with an I/DD tend to have Medicaid as their primary coverage [1]. A frequent site for healthcare in America is the emergency department (ED) [7]. Medicaid patients are known to use the ED more frequently, including for non-emergent care [8]. Non-emergent use of the ED is an inappropriate use of a high cost, high resource utilization setting leading to increased cost and overcrowding [9]. Previous studies have also found that children and young adults with an I/DD use health services and the ED more frequently, regardless of payer [10-12].

Universally, the use of the ED results in increased cost and fragmentation of care when used as a form of primary, nonemergent care [13-16]. A concerning trend is that 37% to 60% of visits are for non-urgent concerns [17-24]. An increase in overall ED utilization was seen from 1994 through 2012 for all children [25, 26]. When looking at the ED utilization of children and young adults with an I/DD, various study approaches have been utilized, but a clear national description of this population's utilization pattern has not been established. For example, studies have looked at one health system or patient reported information [12, 27-36], a singular state's population [37-44], or have not been stratified across the whole spectrum of I/DD, but a specific diagnosis within that category [11, 28, 29, 40, 41, 45, 46]. Studies that used national data, primarily the

Healthcare Utilization Project National Emergency Department Sample and the Agency for Healthcare Research and Quality Medical Expenditure Panel Survey, found visit rates ranging from 0.22 to 0.37 visits per child each year and an increased odds ratio for pediatrics with an I/DD diagnosis ranging from 1.06 to 1.99 compared to a non-disabled child [11, 45-53].

The goal of this dissertation was to describe and define the characteristics of ED use among children and young adults with an I/DD. This was be achieved through analyzing a repeated, cross-section of annual data from a balanced national sample. This approach was used to document the primary clinical reason for ED use, the appropriateness of the need for a visit, and demographic, geographic, and temporal correlates for medical care, psychiatric care, and injury care in the ED. The utilization of the ED by children and young adults with an I/DD was be documented across years. The information identified in this dissertation can assist policymakers and stakeholders of patients with an I/DD to develop interventions/decisions to support this already vulnerable population and their families/natural supports.

Background and Conceptual Framework

The body of literature looking at emergency department (ED) utilization for this population was vast and all articles viewed ED utilization as an area of growing concern. Willits et al. (2012) stated, "Emergency department utilization is a significant indicator of the performance of a health care system.[36]" It was found that individuals with an I/DD are higher users of the ED than typically developed populations.

Background

The findings from the literature were classified into six-subcategories based on the sampling used in the study's analysis. The most limiting analysis, based at a singular health system or hospital, was used in three studies. Nine studies looked at multiple counties or a complete state for their analysis. Five studies used the HCUP NEDS, which is the largest all-payer database in the United States [54]. Six studies used the AHRQ MEPS as their data source. The MEPS "is a set of large-scale surveys of families and individuals, their medical providers, and employers across the United States" [55]. Two studies used a multi-state private payer database. Lastly, seven studies used other national survey datasets including the National Health Interview Survey and the National Survey of Children's Health.

Literature Review Method

The question for the literature review was: What is the utilization of the emergency department by pediatrics and young adults with a developmental disability or a child with special health care needs (CHSCN)? It was decided to broaden the review of the literature to include CHSCN in the population of interest to gain a broader picture of pediatric and young adult utilization of the emergency department with complex

medical needs. A CHSCN is defined as, “those who have or are at increased risk for a chronic physical, developmental, behavioral, or emotional condition and who also require health and related services of a type or amount beyond that required by children generally” [56]. From this question, a search was completed in both PubMed and OVID. The search criteria used is in Figure 1.

children with special health care needs OR CSHCN OR autistic disorder* OR developmental disabilities* OR intellectual disability* OR cerebral palsy* OR mental retardation

AND

pediatric* OR young adult*

AND

emergency services, hospital* OR emergency department OR emergency room

AND

article must have an abstract, be written in English, and self-identify as human centric

* = Key Terms as Determined by NIH Library

Figure 1 NIH Library Key Terms and Boolean Operators

Studies were included in the literature review utilizing the inclusion/exclusion criteria in Figure 2 below.

- Centers on (at least one):
    - Children with Special Health Care Needs (CSHCN)
    - Autistic Disorder
    - Developmental Disabilities
    - Intellectual Disability
    - Mental Retardation
    - Cerebral Palsy
- Centers on (at least one):
    - Pediatric
    - Young Adults
- Focuses on Emergency Department/Emergency Room utilization
- Study is a randomized control trial, cohort study, case/control study, or cross-sectional study.

Criteria for exclusion:

- Centric on a drug treatment/intervention
- Centric on a clinical care intervention (ex. Utilization of an x-ray image or CT scan)
- Centric on biological mechanisms
- Non-human based study
- Study based outside of the United States

Figure 2 Inclusion/Exclusion Criteria for Literature Review

Hospital Analysis

Three studies used data from a singular hospital. Two of these studies looked at the rate of visits; one found that a population of children with special health care needs (CSHCN) had 4.23 visits per child-year [27]. Another study looked at children with a diagnosis of ASD and found that of 130 pediatrics, a total of 160 visits were captured during the year of the study, of which 44% occurred after office hours [28]. The last study calculated a predictive model and found that the diagnosis of ASD decreased the risk of ED utilization, with an Odds Ratio (OR) of 0.61 [29]. This study was based at a tertiary children's hospital, causing for potential selection bias in the analysis as the control group may have higher acuity of care needs. More details on these studies are in Table 1.

State Level Claims Data

Analysis that looked at state level data had different outcome points in their analysis. The simplest study looked at the percentage of a population who used the emergency department. They found that 34.86% of their study sample with Fragile X used the ED during the study period [41]. Other studies looked at the rate of ED use among the population. Two studies looked at developmental disabilities and found a rate of 0.55 to 1.00 units per patient per year [37, 42]. Three studies looked at CHSCN and found a rate of 0.34, 1.063, and 1.92 visits per patient per year [38, 43, 44]. A fourth study looked at a CHSCN population but specifically looked at CHSCN who were medically complex and dependent on a medical technology device for life sustainment. It was found that this sampled averaged 0.29 ED visits per month per patient or 3.48 visits per year per patient [57].

One study used the treatment received at the ED visit as their outcome. They looked at the relative rates of children with ASD and found a relative rate (RR) of 1.47 for head, face, and neck injuries and 0.54 for strains and sprains [40]. This indicate that this is a higher acuity of treatment for children with ASD when using the ED. This study also looked at several different disability diagnoses and modeled their predictive probability of having an ED visit. It was found that adolescents diagnosed with an Intellectual Disability (ID) had the highest utilization probability, followed by those with a diagnosis of Fragile X, and lastly ASD [39]. The trend was also seen for young adults, an individual with a diagnosis of an ID had the highest rate of predicted ED visits, followed by a diagnosis of ASD and then Fragile X [39]. Another study looked at the Ohio population and compared CHSCN with typically developed children across all

payers. It was found that CHSCN had a 2.34 OR (95% CI 1.71-3.22) of using the ED [58]. More details on these studies are in Table 1.

Healthcare Utilization Project Analysis

Five studies used the Healthcare Utilization Project's National Emergency Department Sample (HCUP NEDS) dataset. HCUP NEDS is completed each year with approximately 30 million ED visits and when weighted estimates approximately 135 million ED visits [54]. Two studies looked at the presence of an ASD diagnosis during that unique visit. This group of studies identified very similar findings, 0.27% and 0.29% of each encounter had a patient with a diagnosis of ASD [11, 46] Another study developed a predictive model for psychiatric ED visits for children with ASD. The findings were staggering, with a 9.13 OR (95% CI 8.61-9.70) associated with a diagnosis of ASD and a primary psychiatric diagnosis for their ED visit [45].

A similar analysis for children with a developmental disability (DD) and non-traumatic dental conditions found that the co-occurring DD did not cause statistically significant ED utilization, OR=1.06 (95% CI=0.91, 1.23) [47]. Another analysis using HCUP NEDS looked at the difference in ED utilization for children with a diagnosis of ASD living in rural and urban portions of the country. It was found that children living in rural communities had a higher utilization of the ED, OR=1.16 (95% CI=1.04, 1.30) [59]. More details on these studies are in Table 1.

Agency for Healthcare Quality and Research-Medical Expenditure Panel Survey

The Agency for Healthcare Research and Quality Medical Expenditure Panel Survey (AHRQ MEPS) began in 1996 with the goals of understanding how Americans use health services, their frequency of use, and the cost associated with them [60]. Six

studies used the AHRQ MEPS dataset looking at a diagnosis of CSHCN for a pediatric population age zero to 17 or 18 years old. Three studies calculated the rate of visits among this population. This ranged from 0.20 to 0.37 visits per child per year to the ED and an overall range of ED visits from zero to 11 [51-53]. Further analysis also found that 22% of all pediatric ED use was by a CSHCN [52].

A five-question screening tool was developed to assess severity of CSHCN. This five-question assessment was completed by a ED nurse. This screening tool measured for a need for prescription medication, need for medical care, functional limitation, need for special therapies, or treatment/counseling for a developmental/behavioral problem [61]. An analysis with the AHRQ MEPS dataset found that the higher a patient scored was correlated with a higher rate of ED utilization with a severity of four or five having 0.50 visits per child per year [50]. A predicative model found a 1.99 OR (95% CI 1.59-2.50) for CSHN having two or more ED visits compared to a child without a CSHCN [49]. Lastly, a financial analysis was completed and found that the average ED expenditure for CSHCN was $64 for the sample, regardless of ED utilization or not, with overall average annual expenditure of $2,131 per child. The ED accounted for three percent of overall CHSCN expense [48]. More details on these studies can be found in Table 1.

Multi-State Private Payer Database

A study used the MarketScan Commercial Claims and Encounters Database assembled by the Truven Health Analytics is a sample included 14.70% of HMO covered individuals and 63.45% of PPO health plans of individuals between 12-21 years old. The study found an increase from 3.1% of the population with an ASD diagnosis who used

the ED in 2005 up to 15.8% who use the ED in 2013. There was no temporal change in ED utilization, 3.0% who used the ED in a given year, for the sample without an ASD diagnosis [62].

A different study used the Clinformatics Data Mart Database assembled by Optim Health and is a sample of 16,338 individuals who had a ICD-9 code associated with ASD at some point in their record from 2000 to 2013. The individuals in this dataset were 16 to 23 years old. It was found that there was no significant difference in ED use between age classifications and no change in rate of utilization amongst this sample [63]. More details on this study can be found in Table 1.

National Surveys

Seven studies used various different national surveys for their analysis. One studied utilized the National Health Interview Survey to study the DD population and found that 10.3% of the sample with a DD used the ED and 16.3% of the sample used the ED if they had three or more DD's [12]. Another study utilized the National Health Interview Study, but studied CSHCN and found 23.9% of the sample used the ED. Children 12 to 17 years old with CSHCN had a 1.28 OR (95% CI 1.05-1.55) of using the ED in a year compared to a sample of children 5 to 11 years old also with CHSCN [36].

Three studies used the National Survey of Children's Health and found an ED utilization rate of 14.5% to 34% of their respective samples used the ED in a one-year period [30, 33, 36]. A state based study using the California Health Interview Study found that, among a sample of CHSCN, that 30.0% of the immigrant sample and 43.5% of the U.S.-born sample used the ED annually [31]. Lastly, a study using the National Survey of Supplemental Security Income-Children and Families found that children age

zero to 17 who qualify for Supplemental Security Income that 44% of the sample used the ED, in addition, 15.6% of the sample had three or more ED visits in a year [34]. More details on these studies can be found in Table 1.

Conclusion

The conclusion of a studying using the National Health Interview survey found, "Children with DDs use disproportionately high rates of health services relative to children without DDs. Additional research is warranted and should include further evaluation of early intervention services and potential population effects, trends in access to care, and the prevalence of unmet healthcare needs among children with DDs" [12]. These findings are an exclusive summary of all the literature included in this review. A study by Agrawal and Smith (2014) determined that research on Medicaid spending was needed and researchers should not look simply at the delivery system but the non-healthcare factors, including poverty, food insecurities, and unemployment, that drive the use of care [64]. The aim of this dissertation will include further analysis of population effects and the prevalence of unmet healthcare needs among children and young adults with a I/DD across all disabilities and payers.

Conceptual Framework

Adapted from the Anderson & Aday model, shown in Figure 3, a conceptual framework was established for this dissertation [32]. This framework considers not only the patient characteristics utilizing the healthcare system but also the overall characteristics of the delivery system. This framework has been used in other studies examining ED use for individuals with an I/DD.

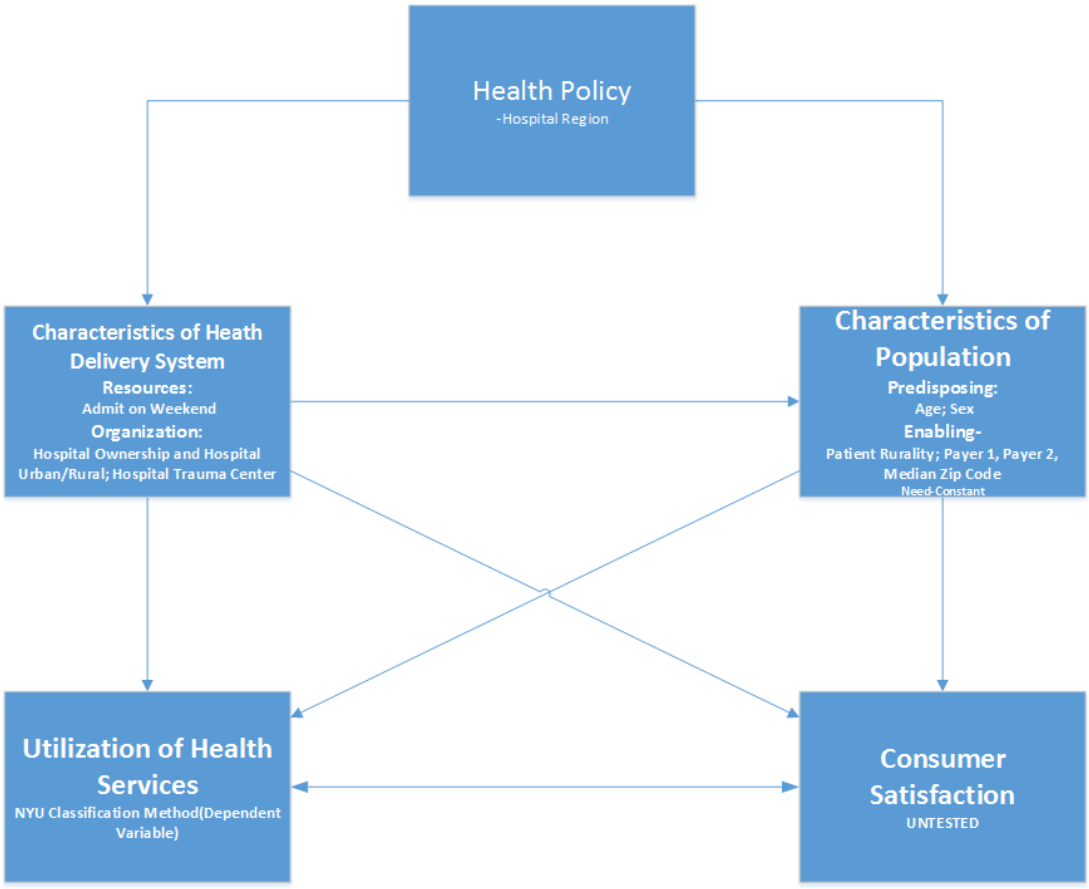

Figure 3 Adapted from Anderson & Aday, the dissertations conceptual framework

Four reviewed studies have applied the conceptual framework to different data sets: one hospital level data set, one nationally representative claims data set, and two national, self-reported patient/family surveys [29, 35, 36, 65]. Each study looked both at the characteristics of the delivery system and the patient characteristics.

Methods

This dissertation will conduct a repeated, cross-sectional analysis of a collective, balanced, and secondary national data sample.

Population of Interest

The sample for this study will be children and young adults who are between three (3) and 25 years old at time of visit and an I/DD is recorded for that visit. No restrictions will be placed on other demographic characteristics for this study. Four developmental disabilities will be specificity studied: autism spectrum disorder (ASD), cerebral palsy, learning disabilities, and spina bifida. These diagnoses and the National Institute of Health (NIH) MedLine Plus definition are listed in Table 2 with their matching International Classification of Disease, Ninth (ICD-9) classification codes as determined by the Center for Medicare and Medicaid Services (CMS) [2].

Dataset

The Healthcare Utilization Project National Emergency Department Sample (HCUP NEDS) developed and distributed by the Agency for Healthcare Research and Quality (AHRQ) is used for this analysis. HCUP NEDS is assembled each year with approximately 30 million ED visits representing 135 million weighted ED visits from the HCUP State Inpatient Databases and State Emergency Department Databases [54]. HCUP NEDS data contains visit and facility level information. This study will use six years (2009 through 2014) of HCUP NEDS data. Across those six years there is a total of 48,436,899 unique visit records in the data set that represent 216,660,781 visits accounting for the survey sample weight. When the I/DD and pediatric/young adult population requirement is applied to the data set the final sample size is 386,632 unique

visits with a weighted sample size of 1,598,489. Institutional review board (IRB) approval was deemed exempt for human subjects for this study, given that the data set is classified as a limited data set under the HIPAA Privacy Rule by AHRQ [66].

Reason of Emergency Department Visit

Three different analysis were completed as part of this dissertation. The primary dataset was stratified into three mutually exclusive datasets based on reason of the individual visit: medical utilization, psychiatric utilization, and injury utilization. A visit was recorded as psychiatric or injury per HCUP NEDS classification methods [67]. All other visits will be classified as medical. Those in the medical dataset will be furthered defined by the New York University (NYU) Emergency Department Diagnosis Classification method [68]. The classification is shown below in Figure 4.

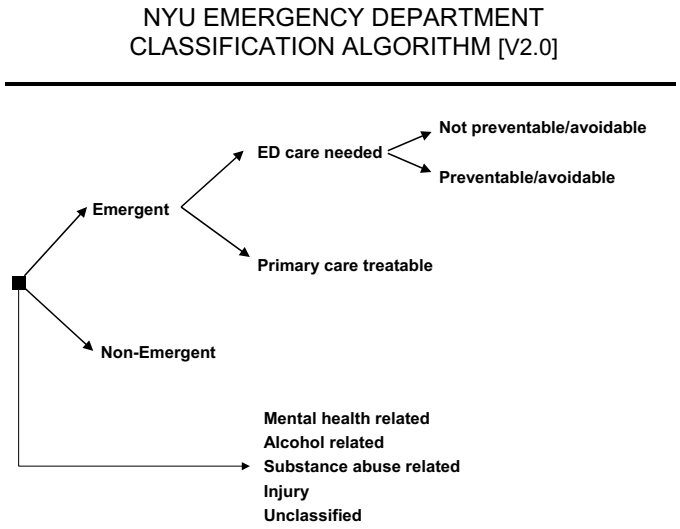

Figure 4 NYU ED Algorithm Classification

This algorithm was created by an expert panel that assigned probability, based on primary diagnosis in the ED (ICD-9) that the visit was for non-emergent or emergent care [68]. Non-emergent care indicates immediate care was not needed within 12 hours. The

emergent category, meaning care is needed within 12 hours, was further expanded to state that the visit could have been treatable in a primary care setting or required ED treatment. Primary care treatable care means continuous observation was not needed and no procedure was performed. Diagnoses that were deemed to require ED care were further classified and considered avoidable or not avoidable by the expert panel. An example of ED care required but avoidable would be flare-ups of asthma or diabetes. An example of ED care required but not avoidable would be appendicitis or a heart attack. Each diagnosis had a probability for these four categories [68]. This method excludes visits that were: mental health, alcohol, substance abuse, or injury related. In addition, the expert panel did not have enough information on some ICD-9 codes and were thus unclassified in the algorithm.

In addition, further work was done by Ben-Isaac, Schrager [9] to create additions to the NYU algorithm for pediatrics. Table 3 displays the additional codes that are included in the current study. Specifically, if these pediatrics codes are present as a primary diagnosis at visit, they were coded as non-emergent or a value of 1 for the complete sample.

Data Variables

The variables available in HCUP NEDS and components of the conceptual framework were compared and the variables of interest for this dissertation are listed in Table 3 on page 57. The hospital level variable utilized in the analysis is the ED's trauma level as defined by not being a trauma center, a Level I trauma center, a Level II trauma center, or a Level III trauma center. At the patient visit level utilization of the ED on the weekend is reported.

Patient characteristics also included age as a continuous variable which was recoded into four categories: preschool (3-5), elementary age (6-11), middle/high school (12-18), and young adult (19-25). HCUP NEDS reports the sex of the population. The data set reports up to two payer sources (primary and secondary) for each visit as Medicare, Medicaid, Private Insurance, or Self-Pay. The average income for the patient's zip code standardized into four different quartiles by HCUP. The patient's rurality, as determined by the Zip Code and the United States Department of Agriculture (USDA) was analyzed into six different categories listed in Table 4.

Analysis

An alpha of .05 was used for all analysis portions of this dissertation. All data management and analysis were completed in SAS 9.4.

Disability Correlation

The classification of the population of interest was based on ICD-9 codes. For HCUP NEDS data 2009 to 2013 had the potential for 15 ICD-9 diagnosis codes and 2014 had the potential for 30 ICD-9 diagnosis codes. A correlation matrix was created for the overall dataset and each of the sub-data set using Pearson Correlation. If the correlation was greater than 0.6 a correction was used in model specification.

Medical Utilization

Assumptions of normality for each variable was tested. Variables that did not meet analytical assumptions were transformed (square root, exponent, log, etc) to meet normality assumptions and were noted in the results sections. Bivariate analysis was completed. This compared the variable to the outcome variable, non-emergent visit to the ED utilizing a Chi-Square test for each variable.

From the NYU algorithm, the outcome variable (dependent variable) were classified as 1-nonemergent and 0-emergent for the medical visits model. If the percentage for non-emergent is equal to or greater than 50% then it was coded as a 1. If the percentage for the other three categories was classified as 50% or higher then it was coded as a 0. A logistic regression was specified using the NYU Outcome Variable. The quality of the models fit for each analysis used the c statistic [69]. The sensitivity of each variable added to the model was tested and the final model included a subset of the variables listed in Table 5. Two different models were specified based on disability. One model included the presence of each individual disability with the potential for more than one disability to be identified at a visit. The second model included a variable that is a count of the number of I/DD's recorded for that patient at that visit.

After the medical care models were specified, a collinearity analysis was completed for interaction between the independent variables. Two different analysis were competed. First, a Chi-Square for each independent variable interaction was executed. In addition, both the Lambda Symmetric and Uncertainty Coefficient Symmetric measures of association were calculated [70]. Secondly, the Mallow's C(p) criterion for the model was calculated via the Proc Reg function in SAS [69].

Injury and Psychiatric Utilization

Two additional models were specified with the other two sub-datasets, injury and psychiatric utilization. For model specification, the injury and psychiatric dataset was combined back with the medical utilization dataset. The outcome variable of interest for each model was psychiatric or injury visit coded as a 1 and medical visit coded as a 0. Further information on both of these models are listed in Table 4. The quality of the

models fit for each analysis used the c statistic [69]. The sensitivity of each variable added to the model was tested and the final model included a subset of the variables listed in Table 5. Two different models were specified based on disability. One included the presence of each individual disability with the potential for more than one disability to be identified at a visit. The second model included a variable that is a count of the number of I/DD's recorded for that patient at that visit.

For both the psychiatric and injury datasets a collinearity analysis was completed for interaction between the independent variables. Two different analysis were completed for each data set. First, a Chi-Square for each independent variable interaction was executed. In addition, the Lambda Symmetric and Uncertainty Coefficient Symmetric measures of association was calculated [70]. Secondly, the Mallow's C(p) criterion for each model was calculated via the Proc Reg function in SAS [69].

Results

Data Overview

For years 2009 to 2014 there are a total of 48,436,899 pediatric and young adult visits age 3 to 25 in the sample. When the sample weight was applied there is a weighted sample size of 216,660,781. When the disability classification criteria were applied to the sample the final sample represents 386,632 visits and a weighted sample of 1,598,489. The temporal trend of the sample size can be found in Table 6. The prevalence of disease across time are displayed in Figure 5. The incidence of Cerebral Palsy, Intellectual Disability, and Spina Bifida remains near constant across the six years of the sample.

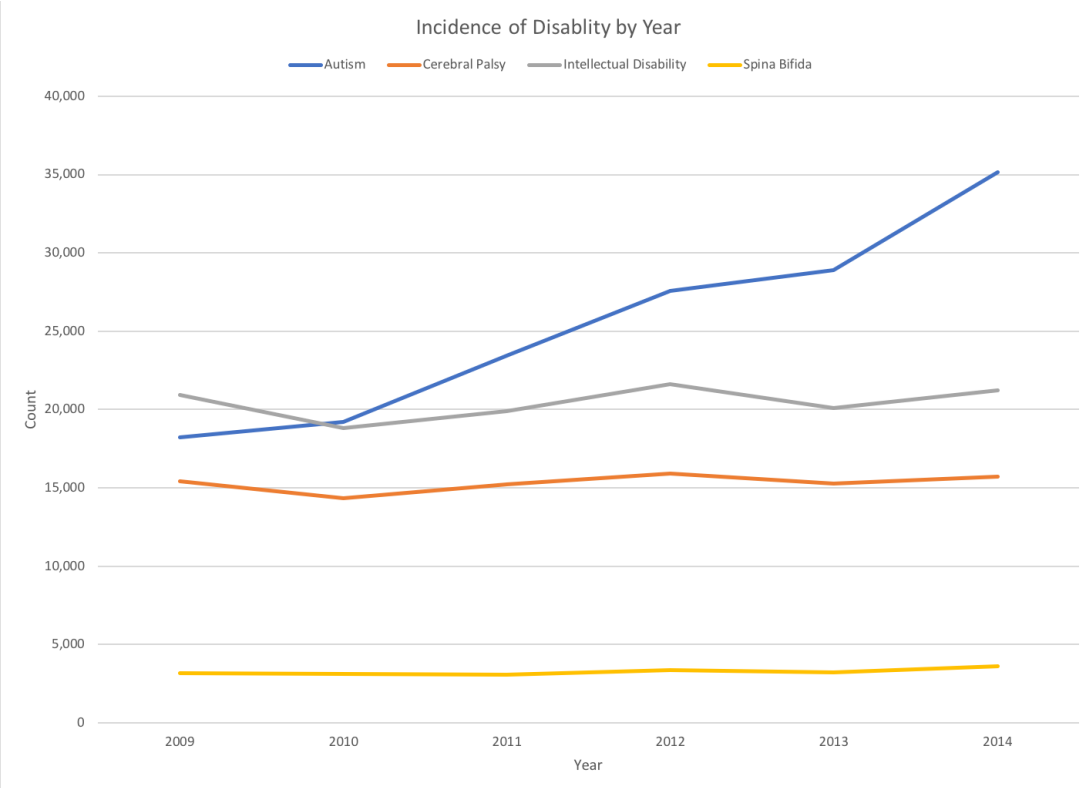

Figure 5 Incidence of Disability by Year

Cerebral Palsy accounts for roughly 0.20% of the overall weighted sample, Intellectual Disability account for 0.27% of the weighted sample, and 0.05% of the Spina Bifida. We see an increase of ASD incidence across the sample time. We also saw an increase from 0.22% of the weighted sample to 0.45% of the weighted sample across time. More information on the sample size across time is found in Table 7.

Figure 6 displays the incidence of each disability in the sample by type of ED visit. The majority of the sample, 67.7%, are for medical care visits. We see a near equal contribution of medical visit total coming from those diagnosed with Autism, Cerebral Palsy, and Intellectual Disability. Due to a small incidence of Spina Bifida that diagnosis only accounts for 6.5% of the medical care visits. Psychiatric visits account for 15.2% of the overall visits in the sample, with 94.7% of psychiatric visits coming from children and young adults diagnosed with ASD or Intellectual Disabilities.

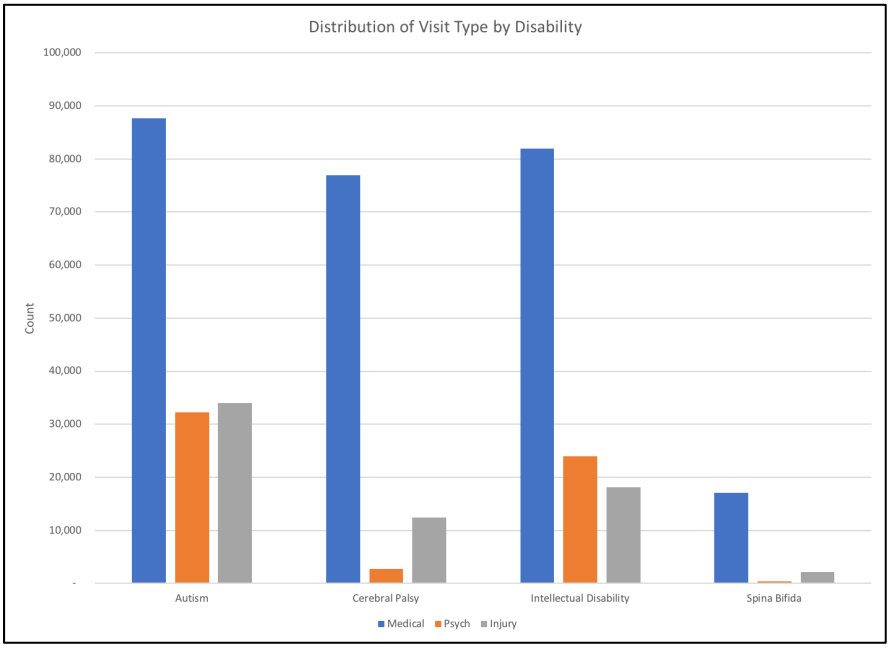

Figure 6 Distribution of Visit Type by Disability

Injury visits account for 17.1% of the overall sample, of which 78.3% of the injury visits were diagnosed with ASD or Intellectual Disabilities.

Overall Disability Correlation

Table 8 shows the Pearson Correlation between each of the I/DD's studied within this dissertation. It is shown that all the correlations are highly significant (p-value <.0001). Overall, a diagnosis of ASD is moderately correlated to Cerebral Palsy (-0.482) and Intellectual Disability (-0.503). ASD is mildly correlated to Spina Bifida (-0.206). The correlation of Cerebral Palsy with Intellectual Disability (-0.182) and Spina Bifida (-0.058) and the correlation of Intellectual Disability with Spina Bifida (-0.122) are also mild.

Medical Care

Descriptive Statistics

Analysis on the dataset representing all medical care visits found that among top 10 diagnoses across all disabilities epilepsy or other convulsive disorders was the most frequent and secondary was upper respiratory infection. The top 10 diagnoses accounted for 28.1% to 35.1% of all diagnosis for each disability. The top 10 diagnoses for each disability are listed in Table 9. When compared across years for the all I/DD population there is no noticeable change, epilepsy or other convulsive disorders was the top diagnosis and pneumonia and upper respiratory infection was the second most common primary diagnosis. The top 10 diagnoses across year for all I/DD are listed in Table 11.

Analysis of the primary procedure performed at the visit found an undescriptive ED visit level one to five was the majority of the recorded codes. Visits other than an unspecific ED visits were for imaging (Cat Scan and X-ray) and for vascular puncture or

gastro tube placement. The top 10 Current Procedural Terminology (CPT) procedure codes account for 69.9% to 78.6% of all procedures for each disability. The top 10 procedures for each disability are listed in Table 10. When looking across years for all I/DD no major variation was seen with ED visit level one to five was the majority of reported procedures. The top 10 CPT procedure codes account for 72.9% to 77.4% of all procedures for each year. The top 10 procedures for all disabilities across time are listed in Table 12.

The NYU algorithm was applied to the primary diagnosis of the data set. It was found that the prevalence of non-emergent care increased from 2009 to 2014, as shown in Table 13. In addition, visits in the ED that could have been treated in the primary care office has increased across time 2009 to 2014. Positively, we saw a decrease in ED care that was preventable (ie. exasperation of diabetes or asthma) but negatively saw an increase in non-preventable ED care (ie. heart attack). It was also found that 31.2% to 34.7% of the visits did not have enough information to be classified in the NYU algorithm.

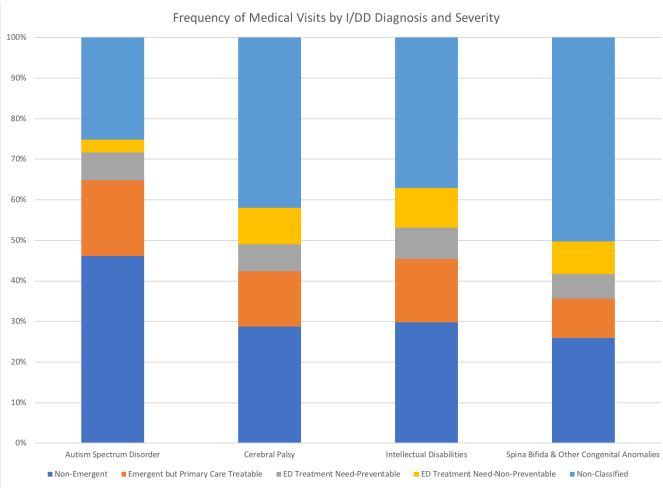

Figure 7 Frequency of Medical Visits by I/DD Diagnosis and Severity

The NYU algorithm stratified by each I/DD diagnosis found that individuals diagnosed with ASD saw a higher prevalence of non-emergent care (44.6%) and only 3.1% of visits were classified as ED care needed and not avoidable, as shown in Figure 7 and Table 14. Conversely, the three other diagnoses saw a range of 8.1% to 9.9% that were higher than ASD classified as ED care needed and not avoidable and only 25.9% to 28.8% was classified lower than ASD as non-emergent. We found that only 49.8% of the visits for Spina Bifida that were not excluded could be classified by the NYU algorithm, yet 75.7% of the ASD visits were classified.

Bivariate and Correlation Analysis

The bivariate analysis, presented in Table 15, of the medical care visits found that each of the variables tested were significantly different between non-emergent visits and emergent visits. It was found that non-emergent visits were more likely to be admitted on the weekend than emergent care as shown in Figure 8. Non-emergent care visits were more likely to be at a non-trauma center or unclassified than emergent care. Emergent visits were more likely to be at Level 1 Trauma centers. It was also found that non-emergent visits were from younger (Figure 8) and males compared to emergent visits.

Figure 8 Medical Visits Demographics

While there was a statistical difference between emergent and non-emergent visits on payer source the actual difference was minor. Non-emergent visits tended to be from patients with public payer source (Medicare and Medicaid) as the primary payer (Figure 8) but if the patient had a second payer source, the second source tended to be from private insurance or self-pay for non-emergent visits. In addition, the non-emergent patients tended to live in a lower zip code income area and in a suburban or rural community compared to patients with emergent visits (Figure 8).

The correlation between disabilities amongst the medical care visits is similar to the overall correlation. All correlations are statistically significant. ASD is moderately correlated with Cerebral Palsy (-0.489) and Intellectual Disability (-0.454) and mildly correlated with Spina Bifida (-0.206). Cerebral Palsy is mildly correlated with Intellectual Disability (-0.195) and Spina Bifida (-0.095). Intellectual Disability is mildly

correlated with Spina Bifida (-0.136). The correlation table for medical care is in Table 16.

Logistic Regression Models

Two logistic regression models were specified for medical care visits comparing non-emergent care visits with emergent visits. The difference between the two models was the disability variable. The first model included each disability which allowed for multiple disabilities to be represented per visit. The findings were similar to the bivariate analysis. Admission on the weekend had a higher Odds Ratio (OR) 1.052 (95%CI 1.032-1.072). Level 1 trauma centers were more likely to have a non-emergent visit than a non-trauma center. The older the patient was, the higher their odds of having a non-emergent visit. Non-emergent visits were more likely for those with private insurance OR 1.100 (95%CI 1.076-1.124) compared to the Medicaid population.

The income in the zip code of the patient resident found that the higher the income, the greater likelihood of having a non-emergent visit. The patient rurality was not a significant predictor with the only significant odds ratio comparing the large metro county with the central county. It was found that the sex of the patient was not a significant predictor. The year of the visit showed that the likelihood of a non-emergent visit was variable across the time period with no clear trend.

When each individual disability was in the model, they were all statically significant and all are shown to lower the odds of a non-emergent visit. The incidence of Autism has the largest odds, 0.947 (95% CI 0.915-0.981). When the classification of each individual disability is removed but the overall total count of disability is entered, it was found that the greater amount of disabilities the greater the odds of having a non-

emergent care visit. The incidence of two co-occurring disabilities has a OR of 1.825 (95% CI 1.767-1.884) and incidence of three co-occurring disabilities has a OR of 2.747 (95% CI 2.4223.115).

The model that included each individual disability had an overall c statistic of 0.617 and the model that included the amount of disabilities coded at a visit had a c statistic of 0.596. The full logistic regression results for the model including individual disabilities can be found in Table 17. The full logistic regression results for the model including a total disability count variable can be found in Table 18.

The collinearity analysis of the medical care visits across all three measures of association, Chi-Square, Lambda Symmetric, and Uncertainty Coefficient Symmetric found that five potential interactions deemed extra attention. They were patient rurality with income in patient zip code quartile and ED trauma level and primary payer source with income in patient zip code quartile, secondary payer source, and age. Full information on all associations can be found in Table 19 for the individual disability model and Table 20 for the total disbailty model. The result of the Mallow's criterion is shown in Figure 9 for both each disability included and the total disability count models.

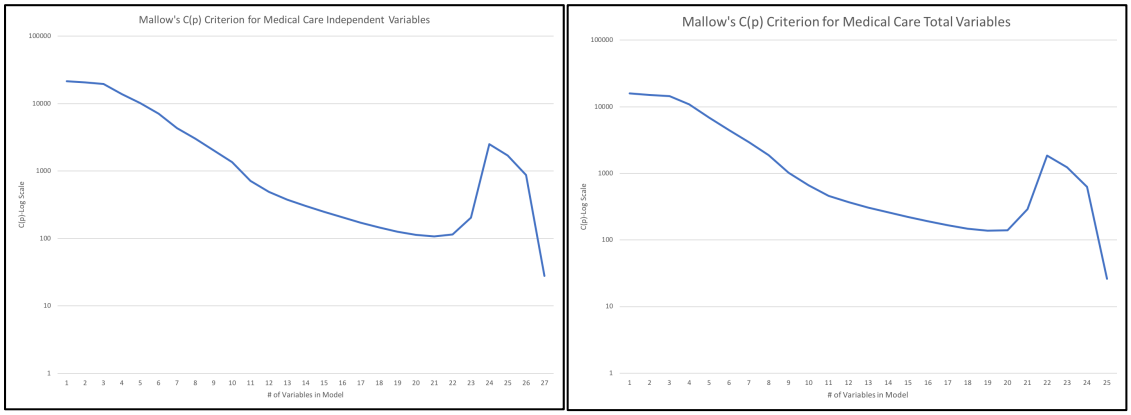

Figure 9 Mallow's Criterion for Medical Care Models

It is shown that the minimum Mallow's Criterion was 21 in both models when all 27 interactions amongst the independent variables of interest were included in the model.

Psychiatric Care

Descriptive Statistics

Analysis on the dataset representing all psychiatric care visits found that among the top 10 diagnoses across all disabilities ASD was first and secondary was unspecific episodic mood disorder. The top 10 diagnoses accounted for 34.9% to 52.6% of all diagnosis for each disability. There is a low amount of patients with Spina Bifida and psychiatric ED visits so only the top seven visits are listed per AHRQ HCUP data use agreement [66]. The top 10 diagnoses for each disability are listed in Table 21. When compared across years for the all I/DD population there is no noticeable change, Autistic Disorder is the top diagnosis and episodic mood disorder is the second most common primary diagnosis. The top 10 diagnoses across years for all I/DD are listed in Table 23.

Analysis of the primary procedure performed at the visit found an undescriptive ED visit level one to five was the majority of the recorded visit codes. Visits other than an unspecific ED visits were for vascular puncture or psychiatric diagnosis evaluation. The top 10 CPT procedure codes account for 52.7% to 88.2% of all procedures for each disability. The top 10 procedures for each disability are listed in Table 22. When looked across years for all I/DD no major variation was seen with ED visit level one to five was the majority of reported procedures. The top 10 CPT procedure codes account for 84.4% to 89.4% of all procedures for each year. The top 10 procedures for all disabilities across time are listed in Table 24.

Bivariate and Correlation Analysis

The bivariate analysis of the psychiatric care is presented in Table 25. All variables tested compared psychiatric visits to medical visits were found to be statistically different. It was found that psychiatric visits occurred more frequently during the week when compared with medical visits, as shown in Figure 10. The trauma classification of the ED used for the visit is statistically different but have similar profiles.

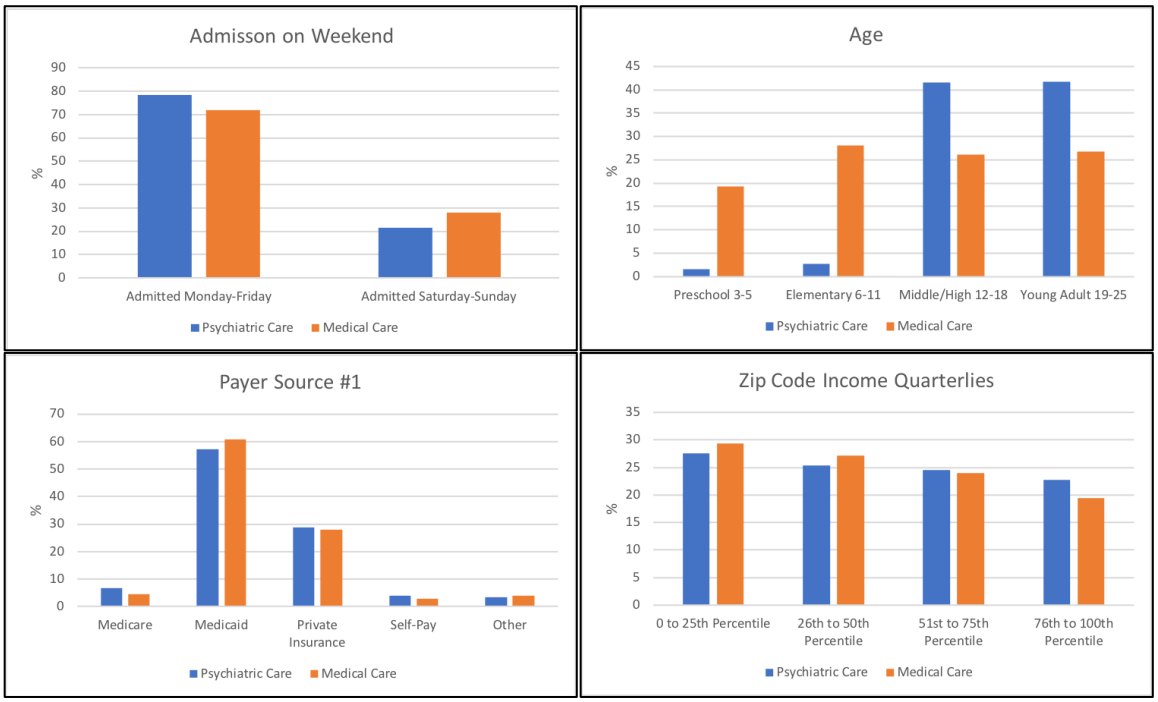

Figure 10 Psychiatric Visits Demographics

The age, as shown in Figure 10, is greatly favored towards those in middle and high school and young adults for psychiatric care rather than medical care. Psychiatric visits were disproportionally more male patients with 70.6% of all visits, compared to medical visits which were 63.2% of all visits. The primary payer source for psychiatric visits tends be similar in its ratio of government insurance compared to medical care visits but had slightly more Medicare coverage than Medicaid insurance as shown in Figure 10. Individuals who had a psychiatric visit had a higher number of individuals

from the top 50th percentile for zip code income compared to medical visits as shown in Figure 10.

The patient rurality for psychiatric visits tend to be from more urban areas than rural with only 12.3% of the psychiatric visits being from rural compared to 14.3% of medical care visits. Lastly, psychiatric visits tended to be mainly patients with a diagnosis of Autism (51.8%) and Intellectual Disability (43.8%) compared to a combined 67.8% of those diagnosed with medical care visits.

The Pearson Correlation matrix for psychiatric visits can be found in Table 26. The correlation among these visits, while statistically significant, was greatly different than medical care. There is high correlation (-0.759) between a diagnosis of ASD and Intellectual disability. There was moderate correlation between a diagnosis of ASD and Cerebral Palsy (-0.230). All other correlations were very low ranging from -0.040 to -0.084.

Logistic Regression Models

Similar to the Medical Care data set, two different logistic regression models were specified. The outcome variable was a psychiatric visit compared to a medical visit. Each model included the same explanatory variables except handled the presence of I/DD differently. One model indicated in a non-exclusive way, the presence of each of the four disabilities and the second model focused on the number of disabilities. Overall, all explanatory variables were significant in both models. Being admitted on the weekend was found to lower the odds of a psychiatric visit. When compared to being classified as not a trauma center it was found that unclassified and trauma level 3 centers had a higher rate of psychiatric admissions.

The age variable for each model had very similar and strong results. Young adults (age 19 to 25) was the reference group it was found that the odds of a psychiatric admission were greatly increased for each of the three-other age categories. Elementary children (age six to 11) had a OR of 3.835 (95% CI 3.713-3.961) in the individual disability model and a OR of 2.995 (95%CI 2.907-3.086) in the overall disability county model. Both models found that males had a lower odd of being admitted to the ED for a psychiatric visit compared to a female. The models both also found that compared to Medicaid, patients with a primary insurance source of Medicare and private insurance had a higher likelihood of using the emergency department for psychiatric care. Similar trends were found, for those with a secondary insurance, that did not having a secondary insurance or the patient's secondary insurance was from a non-governmental source had higher likelihood of psychiatric ED utilization.

Similarly found in both models, income in the zip code showed that the two higher percentile categories had significantly less ED utilizations for psychiatric visits compared to the lowest percentile. The patient rurality found that there was statistically significant more admissions in both models for patients living in a non-metro or micro county compared to a central county.

There was a difference in the models with the results of the temporal year variable. The modeling the individual disabilities found that there was a statistically significant higher odds of psychotic ED utilization in 2011, 2012, and 2013 compared to the reference year of 2009 yet statistically significant decrease odds of admission in 2014 compared to 2009. In the model looking at the count of disabilities there was a statistical decrease in odds of a psychiatric ED admission in 2010, 2012, and 2014 compared to a

reference year of 2009. In the model looking at total disability none of the compared years had a higher odds ratio than the 2009 reference year.

The analysis of each individual disabilities was found that the diagnosis of ASD (OR 2.149, 95% CI 2.062-2.240) and Intellectual Disability (OR 1.383, 95% CI 1.239-1.439) had statistically significant higher odds of being admitted to the ED for a psychiatric reason. The diagnosis of Cerebral Palsy (OR 0.144, 95% CI 0.137-0.151) and Spina Bifida (OR 0.109, 95% CI 0.097-0.123) had statistically significant lower odds of being admitted to the ED for a psychiatric reason. Analysis of the comorbidity of I/DD disabilities on psychiatric ED visits found that the presence of two or three I/DD's at an ED visit had statically significant higher odds of being for psychiatric visits. There was not a statistically significant difference between being diagnosed with one I/DD or four I/DD.

The model that included each individual disability had an overall c statistic of 0.840 and the model that included the amount of disabilities coded at a visit had a c statistic of 0.620. The full results of the individual disability model can be found in Table 27. The full results of the total disability count can be found in Table 28.

The collinearity analysis of the psychiatric care visits showed across all three measures of association, Chi-Squire, Lambda Symmetric, and Uncertainty Coefficient Symmetric found that five potential interactions deemed extra attention. They were the same as in the medical care model patient rurality with income in patient zip code quartile and ED trauma level and primary payer source with patient zip code quartile, secondary payer source, and age. Full information on all association can be found in Table 29 for the individual disability model and Table 30 for the total disability model.

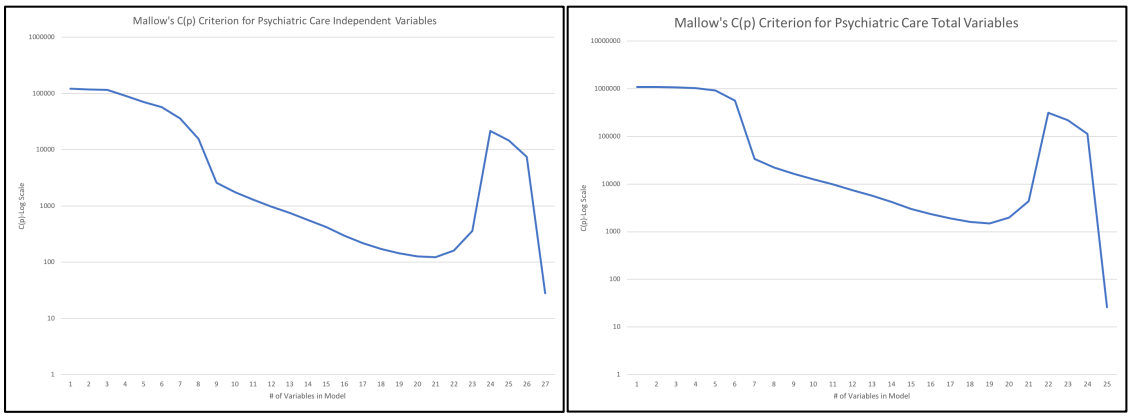

Figure 11 Mallow's Criterion for Psychiatric Care Models

The results of the Mallow's criterion are found in Figure 11. It shows that the minimum Mallow's Criterion is when all 21 interactions amongst the independent variables of interest are included in the each of the models.

Injury Care

Descriptive Statistics

Analysis on the dataset representing all injury care visits found that among the top 10 diagnoses across all disabilities head injury, unspecified was first and secondary was contusion of face, scalp, and neck. The top 10 diagnoses accounted for 24.0% to 28.6% of all diagnosis for each disability. The top 10 diagnoses for each disability are listed in Table 31. When compared across year for the all I/DD population there is no noticeable change, head injury, unspecified is the top diagnosis and contusion of face, scalp, and neck is the second most common primary diagnosis. The top 10 diagnoses across year for all I/DD are listed in Table 33.

Analysis of the primary procedure performed at the visit found an undescriptive ED visit level one to five was the majority of the recorded codes. Visits other than an unspecific ED visits were for computed tomography of the head or brain or simple repair

of body superficial wound 2.5 centimeters or less. The top 10 CPT procedure codes account for 69.2% to 75.8% of all procedures for each disability. The top 10 procedures for each disability are listed in Table 32. When looking across years for all I/DD no major variation was seen with ED visit level one to five was the majority of reported procedures. The top 10 CPT procedure codes account for 73.7% to 75.1% of all procedures for each year. The top 10 procedures for all disabilities across time are listed in Table 34.

Bivariate Analysis

The bivariate analysis of the injury care is presented in Table 35. All variables tested compared injury visits to medical visits were found to be statistically different except for weekend visits. It was found that injury visits did not occur more or less frequently on the weekend than medical visits, as shown in Figure 12. The trauma classification for the ED for the visit is statistically different with a greater percentage of injury visits utilizing an ED not classified as a trauma center.

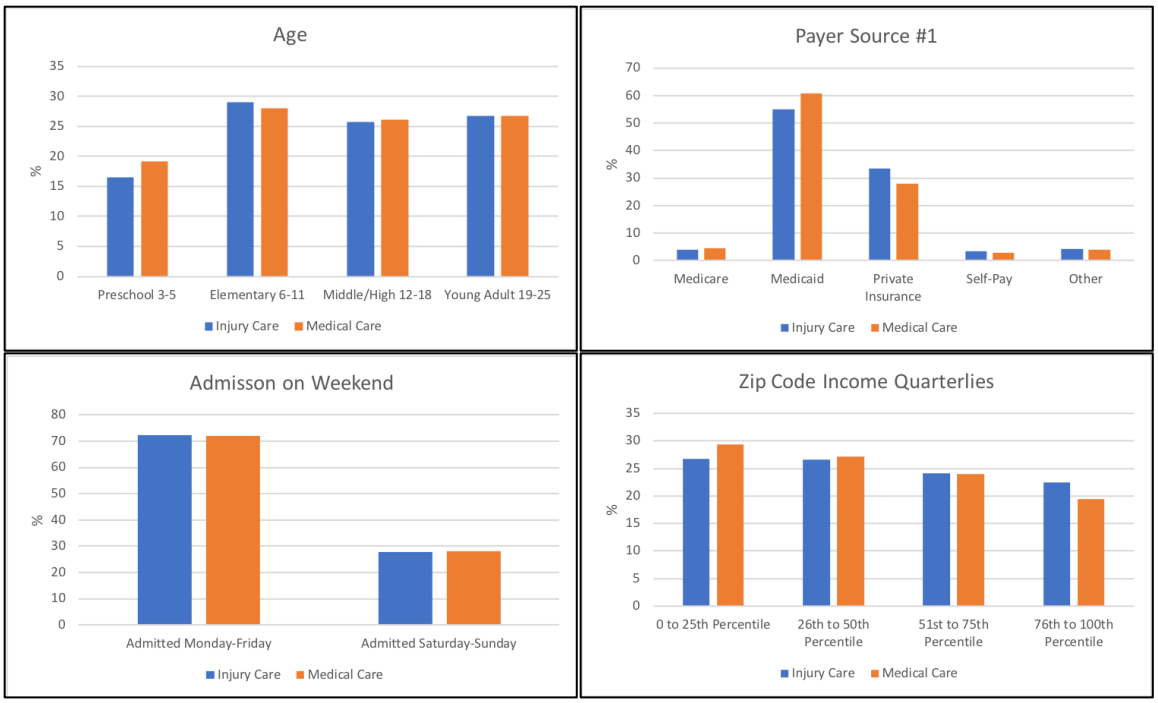

Figure 12 Injury Visits Demographics

The age, as shown in Figure 12, has a similar profile between injury visits and medical visits with roughly a quarter of all visits being each middle and high school aged children 12-18 and young adults aged 19-25. Injury visits were disproportionally male, 71.1% of all visits, compared to medical visits, 63.2% of all visits. The primary payer source for injury visits had a higher percentage of being private insurance, 33.4% compared to 28.0% of all medical visits. Inversely, a lower percentage of Medicaid as primary coverage at the visit, 55.0% of injury visits, compared to 60.8% of all medical visits was reported. Individuals who had an injury visit were more equally distributed across the four-income quartile for patient zip code than medical care as shown in Figure 12.

The correlation among these visits, while statistically significant, was similar to the overall correlation and medical care visits correlation. ASD is moderately correlated

with Cerebral Palsy (-0.498) and Intellectual Disability (-0.558) and mildly correlated with Spina Bifida (-0.200). Cerebral Palsy is mildly correlated with Intellectual Disability (-0161) and Spina Bifida (-0.048). Intellectual Disability is mildly correlated with Spina Bifida (-0.091). The Pearson Correlation matrix for injury visits can be found in Table 36.

Logistic Regression Models

Similar to the Medical Care and Psychiatric data set, two different logistic regression models were specified. The outcome variable was an injury visit compared to a medical visit. Each model included the same explanatory variables except handled the presence of I/DD differently. One model indicated in a non-exclusive way, the presence of each of the four disabilities and the second model focused on the number of disabilities. Overall, the explanatory variables in each model were all significant except the inclusion of a secondary payer source. Being admitted on the weekend was found to have lower odds for injury visits compared to medical visits. When compared to being classified as not a trauma center it was found that Trauma Level 1 and 2 had higher odds of injury visits and Trauma Level 3 and those unclassified had a lower odds of injury visits.

The age variable had different results depending how the disability variable is entered. When each individual disability is entered into the model it is found that preschool aged children (age 3-5) and elementary aged children (age 6-11), OR of 1.112 (95% CI 1.082-1.142), had higher odds of injury admission compared to young adults (age 19-25) but middle/high school aged children (age 12-18) had a lower odds ratio. When the total number of disabilities are entered into the model elementary aged children

no longer have a higher odds of injury admissions but statistically lower odds, 0.947 (95% CI 09.23-0.972).

Both models found that females had lower odds of being admitted to the ED for an injury visit compared to males. The models both found that compared to Medicaid, patients with a primary insurance source of private insurance (OR 0.838, 95% CI 0.820-0.857) or self-pay (OR 0.786, 95% CI 0.746-0.829) had a lower likelihood of using the emergency department for injury care.

Similarly found in both models, income in the zip code showed that the two higher percentile categories had significantly less ED utilization for injury visits compared to the lowest percentile. The patient rurality found that there was statistically significant less admissions in both models for patients living elsewhere than a central county (greater than 1 million population) with the lowest admissions occurring in a Micropolitan town.

The temporal year variable in both models had similar results. With the reference year of 2009, all subsequent years had a statistically significant lower odds ratio of admission for an injury visit. The model looking at non-exclusive individual disabilities had varying odds ratio over time with no trend. The model with number of disabilities, though saw a linear decrease odds of injury admission each year between 2009 and 2014.

The analysis of each of the individual disabilities found that the diagnosis of ASD (OR 1.259, 95% CI 1.212-1.308) had statistically significant higher odds of being admitted to the ED of an injury diagnosis. The diagnosis of Cerebral Palsy (OR 0.587, 95% CI 0.566-0.609), Intellectual Disability (OR 0.765, 95% CI 0.739-0.792), and Spina Bifida (OR 0.490, 95% CI 0.463-0.518) had statistically significant lower odds of being

admitted to the ED for an injury reason. Analysis of the comorbidity of I/DD disabilities on injury ED visits found that the presence of additional disabilities increased the odds of ED visit for injury with two disabilities having an odds ratio of 1.543 (95% CI 1.489-1.600), and 3 or four disabilities had a odds ratio of 1.743 (95% CI 1.524-1.992).

The model that included each individual disability had an overall c statistic of 0.630 and the model that include the amount of disabilities coded at a visit had a c statistic of 0.591. The full results of the individual disability model can be found in Table 37. The full results of the total disability count can be found in Table 38.

The collinearity analysis of the injury care visits showed across all three measures of association Chi-Square, Lambda Symmetric, and Uncertainty Coefficient Symmetric found that five potential interactions deemed extra attention. They were patient rurality with income in patient zip code quartile and ED trauma level and primary payer source with income in patient zip code quartile, secondary payer source, and age.

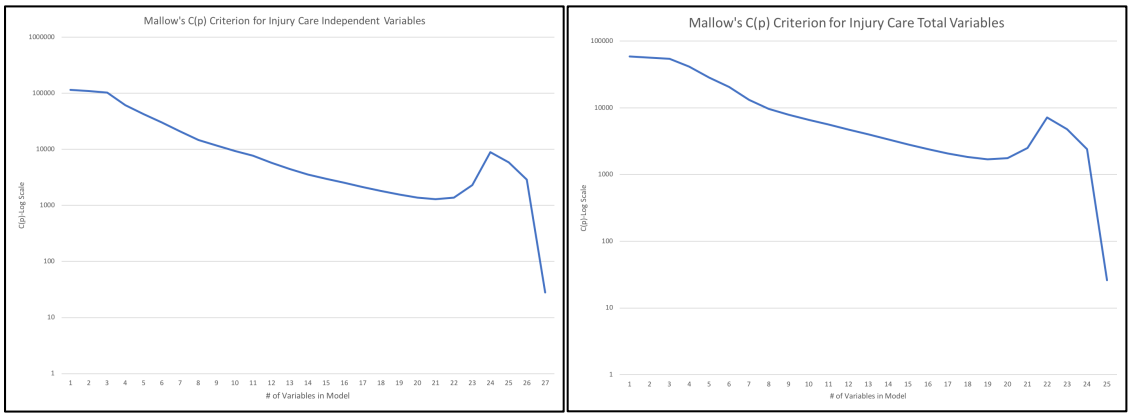

Figure 13 Mallow's Criterion for Injury Care Models

Full information all associations can be found in Table 39 for the individual disability model and Table 40 for the total disability model. The results of the Mallow's criterion are shown in Figure 13.

Discussion & Conclusion

Overall Data

The overall sample obtained from HCUP NEDS included 48,436,899 pediatric and young adults age three to 25. After the application of the disability classification criteria a final sample of 386,632 was analyzed. The final included sample was 0.79% of the overall sample which is near the 1% average prevalence of I/DD in the population [71]. The data also showed high rates of co-occurring disabilities. There was a high correlation between individuals with a diagnosis of ASD with Cerebral Palsy and ASD with Spina Bifida. This co-occurring of disabilities may indicate additional stress on the family or additional complexity of the care of that individual which may result in utilization of the emergency department.

The final sample was further divided into visits for medical, psychiatric, and injury reasons. There were great differences in the division of visits type by disability. Children and young adults with a diagnosis of Cerebral Palsy and Spina Bifida had high rates of medical care visits 83.5% for Cerebral Palsy and 87.2% for Spina Bifida and very low rates of psychiatric care. Individuals with a diagnosis of ASD and Intellectual Disabilities saw roughly 60% of their visits for medical reasons and 20% for each psychiatric and injury reasons. This different use profile per disability may be indicative of different types of interventions needed to better prevent different types of ASD ED visits. It was expected to find similar use profiles of individuals with ASD and Intellectual Disabilities but having a strong correlation between ASD and Cerebral Palsy was not expected. However, different use profiles may indicate that patients with Cerebral Palsy uses the ED differently than a population with only an ASD diagnosis.

Medical Care

The medical visits for all disabilities except Spina Bifida tended to be for unspecified epilepsy and for other upper respiratory infections or pneumonia. Spina Bifida medical visits tended to be for conditions of Urinary Tract Infection and headaches. These symptoms lead to the primary procedure classification of the ED visits to be a level three or four visit across all disabilities. The classification of a level three or level four visit on a five point scale indicates more intensive care was needed to stabilize the patient before release or admission to the hospital [72].

The NYU Classification Method showed similar results, that of the classified visits, nearly half of all visits were emergent for patients except for patients with ASD [68]. These emergent visits are suggestive of patients reaching a comprised health status and needing immediate medical intervention. These measures also highlight that programs, policies, and supports are needed for families to prevent them from reaching an emergent health need for their child/young adult. It was also discovered that half of the classified visits for medical care visits were identified as non-emergent for these three disabilities. Additional education and supports are needed for these families to understand appropriate use of the ED. There is also a need to better understand what is driving ED utilization for non-emergent use. Are these families utilizing the ED because of insurance or long-term care policy's? For example, did an event occur that may not need emergent medical attention but needs to be documented to be in compliance with health insurance coverage policy.

Patients who had a diagnosis of ASD had a different utilization profile compared to the other disabilities. Here we found, among the medical classified visits, that only a

third of the visits were for emergent care and two-thirds were for non-emergent care. This indicates other programs, policies, and supports are needed for this population. It is unknown from this analysis but are parents utilizing the emergency department for perceived medical conditions their child cannot communicate or for true change in patient vitals that cannot be explained by the child due to communication difficulties.

Patient characteristics for non-emergent and emergent visits across all four disabilities indicate several key factors. First, system characteristics from the conceptual framework found that patient and families have minimal ability to change indicate non-emergent visits which tended to occur more frequently on weekend, highlighting a lack of access to out-patient care on the weekends for families to access. This was similar to findings by Cohen-Silver et al (2014) [28]. The data also shows that emergent care tends to utilize a Trauma Center more frequently, which could be associated with longer wait times driving families away from using the emergency department. It may indicate that a Trauma Center is identifying patients with a higher acuity based on their expertise around taking care of medically complex individuals or patients have more familiarity with these emergency department as several children's hospitals are classified as trauma centers. Trauma centers are become more readily accessible with shorter drive times for patients to have access to [73].

Within the predisposing characteristics of the population it was found that patients tend to transition from non-emergent visits to emergent visits as they aged. This may be seen due to greater complexity in the disability and health of the patient. The analysis showed the greatest emergent use was for young adults that could also be related to their transition from pediatric settings (i.e. a traditional K-12 education) to programs geared

for adults. In addition, we saw that patients with emergent visits had a higher proportion of being female greater than their overall presence in the sample. While the I/DD population is disproportionality skewed male, this indicates that programs, policies, and supports for families and patients around emergent care need to be geared to both sexes or two separate programs developed.

Analysis of the patient's enabling characteristics also will assist in the development of program, polices, and supports. We see among our emergent patients that the zip code income quartile that they live in are in the two highest percentiles tend to use the ED more for emergent care where the lower two percentiles use the ED more for non-emergent care. In addition, we see that patients who are on Medicaid as their primary health insurance tend to use the ED disproportionality more for non-emergent care. This could indicate that the income of patients causes barriers to accessing primary care or other outpatient services [10]. These barriers could be related to transportation, ability to access services during the traditional work day, or ability to identify the appropriate outpatient service to care for the medically complex individual.

It was also found that the model that included each disability individually had a higher predictive value than the model that include the overall disability total per patient at time of visit. This could indicate potential differences in utilization patterns by disability that warrants additional analysis. The co-occurring of I/DD diagnosis amongst the medical visit sample was similar to that found in the overall sample data. Strong co-occurring of ASD with Cerebral Palsy and Intellectual Disability was also found.

The collinearity analysis found that there were five potential interactions. Patient rurality with income in patient zip code quartile and ED trauma level as well as patient

primary payer source with income in patient zip code quartile, secondary payer source, and age. Each of these relationships have explanation for the collinearity in practice [69]. Patient rurality has been associated with lower income levels and limited access to trauma centers [73]. There are also known relationships between one's primary payer and income level as the most frequent primary payer source has a financial requirement for qualification [74]. Other payer sources have certain age requirements, for example to qualify for Medicare with a disability you must be over the age of 18 [75]. It was deemed appropriate to include each of these collinearity relationships in the model due to the practical explanation. The Mallow's Criterion analysis showed that the best possible model included 21 of these interactions for both models.

Psychiatric Care

The psychiatric visits for all disabilities except ASD tended to have primary diagnosis of Unspecified Episodic Mood Disorder or Pick's Disease. Pick's disease is a "rare form of dementia that is similar to Alzheimer disease, except that it tends to affect only certain areas of the brain" [76]. Psychiatric visits for ASD tended to have a primary diagnosis of ASD and next Unspecified Episodic Mood Disorder. These symptoms lead to similar ED primary procedures for all four disabilities with visits being primary level three, four, and five. This classification of ED visits was higher than seen in medical care visits, indicating that the ED treatment needed to stabilize these patients are greater.

The co-occurring of I/DD diagnosis amongst the medical visit sample was different than what is seen in the overall sample data. Strong co-occurring of ASD with Intellectual Disabilities was seen but minimal co-occurrence of the other pairs of diagnosis. Patient characteristics for psychiatric care visits across all four disabilities

indicate several key factors. First, characteristics of the health delivery system found that the sample were more likely to utilize the ED for psychiatric care during the traditional work week than on the weekend. The data also shows that psychiatric care is delivered more frequently in a level three trauma center and less likely in a level one or two. This may indicate that patients are utilizing the ED for acute incidences of behavior or mental health that an outpatient care setting is not equipped to provide care. Further, we saw a greatly increased number of psychiatric visits during the work week. This may indicate that when children and young adults are located in a school, childcare, or other day service and the individual has an episode or outburst those settings utilizing the emergency care system more frequently. Further investigation is needed to better understand reasoning for increased utilization during the week.

Predisposing and enabling characteristics of the population were also predictors of psychiatric care. We found, compared to young adults aged 19-25, that younger children had higher odds of psychiatric care. We saw a large odds ratio for the preschool aged children that is inaccurate due to the minimal sample size of children that age with psychiatric visits compared to those with medical visits. This is understandable as it is uncommon to diagnosis a child of that age with a mental health condition. The sample did have adequate sample size to measure increased likelihood of psychiatric admission for elementary and middle/high school aged children. This could be explained similarly to the workweek compared to weekend admission. It could also be that younger children are already in additional treatment and diagnosis and do not have potential negative psychiatric events medically or psychosocially they are under control. Programs, polices, and supports may need to be developed in this area.

Similarly, in the medical care visit sample, we saw that patients with psychiatric visits had a higher proportion of being female greater than their overall presence in the sample. While the I/DD population is disproportionality skewed male, this indicates that programs, polices, and supports for families and patients around psychiatric care need to be geared to both sexes or two separate programs developed.

Opposite of what was seen in the medical care data set, it was found that having private insurance as the primary health insurance increased your odds of having a psychiatric visit in the ED. Further analysis is needed here, as this could indicate that patients with private insurance have mental healthcare and are aware of when to utilize the ED. It could also indicate that individuals with Medicaid may not use the ED for psychiatric care and only when there is a traditional medical concern. Policies and consumer educational material need to be reviewed to ensure that patients with Medicaid have proper support in understanding correct utilization of the ED.

The data also showed that individuals living in a non-metro county had the highest odds of having a psychiatric visit followed by those living in a central county. This could be suggestive of minimal mental and behavioral health treatment providers in rural and central (urban) counties causing patients to utilize the ED for treatment of these concerns. It could also be suggestive of appropriate resources for this population are similar to levels found in suburban areas. The income average in a zip code showed that those living in the highest zip code quartile had the lowest odds of a psychiatric admission. This is supportive of the findings amongst primary payer source and location of residence. Patients living in the higher income portions of a community, generally the suburbs, potentially have adequate resources to care for psychiatric concerns of the I/DD

population. It may also be indicative of appropriate education and guidelines of care for this population.

It was also found that the model that included each disability individually had a higher predictive value than the model that included the overall disability total per patient at time of visit. This could indicate potential difference in utilization patterns by disability that warrant additional analysis. Work by Kalb et al. (2012) found significantly higher OR for ASD patients having psychiatric ED visits compared to ASD medical visits [45]. This dissertation had similar findings amongst the ASD population. The individual disability model had a very high predictive power that was not seen in any of the other models as part of this overall analysis.

The collinearity analysis found that there were five potential interactions, the same interactions were found in the medical care visit data set. Patient rurality with income in patient zip code quartile and ED trauma level as well as patient primary payer source with income in patient zip code quartile, secondary payer source, and age. Each of these relationships have explanation for the collinearity in practice and have been discussed [69, 73-75]. It was deemed appropriate to include each of these collinearity relationships in the model due to the practical explanation. The Mallow's Criterion analysis showed that the best possible model included 21 of these interactions in each model.

Injury Care

The injury visits for all disabilities had the same primary diagnosis of head injury, unspecified and secondary diagnosis of contusion of face, scalp, and neck. In addition, the primary procedure code for all disabilities was a level three ED visit with a secondary

visit code of level two ED visit. The classification of a level three and secondary of level two for procedure code is the lowest all three classifications indicating the lowest level of needed medical intervention to stabilize [72]. This needs further investigation to clarify the intensity of the injury for this population as it was expected that the injury care would be one of the diagnosis needing more emergency services.

The co-occurring of disabilities amongst the injury care visits was similar to the population overall and the medical care visit data set. We saw a moderate co-occurring of ASD with Cerebral Palsy and Intellectual Disability. When first looking at the characteristics of the health delivery system, comparing injury visits with medical visits, there was not a statistical difference between admission during the work week and on the weekend between the two datasets. This could indicate that medical and injury care have similar limitations of access to outpatient care settings on the weekend for families to access. The data did show higher odds of utilizing a Trauma Center Level 1 compared to non-trauma centers. This was expected for the injury care as the more advance injuries would be transferred to a Trauma Center for stabilization and care [73].

The predisposing characteristics of the population for injury care, unlike medical care and psychiatric care, had a sex distribution of care more similar to the overall data set. Roughly 72% of all injury visits were made by male's, compared to only 63% of medical care visits. This could indicate more uniform distribution of injury across the sample. It is also suggestive that programs, policies, and supports should be developed that are more specific to the male population. It was also found that there were higher odds of an injury visit for children aged three to 11 compared to the children 12 to 25. This could indicate that younger children having greater amounts of injuries, or that as

the child grew older the parent and guardians had developed mechanisms to care for injuries at home or in other outpatient settings.

Amongst the enabling characteristics of the population both models also indicated lower odds of injury visit admission for patients who have a private insurance, live in the highest zip code income quartile, and live in a suburban or rural area. It is hypothesized that this is due to increase access to outpatient care settings, similar to an urgent care clinic or weekend primary care office availability for patients with private insurance or living in a suburban area. It is also hypothesized that programs and supports have been put in place to assist this population to better care for patients who have minor injury events. There may also be program policies in place that cause for Medicaid patients to utilize the ED more frequently for less severe injuries. For example, one program requires any patient fall to be reported to the state Medicaid office along with treatment sought, causing a potential incentive to use the ED for evaluation, regardless of patient actual injury at time of event [77]. This could increase the inappropriate utilization of the ED.

It was found that the model that included each disability individually had a higher predictive value than the model that included the overall disability total per patient at time of visit. Similarly, to the other two sub-analysis this could indicate potential differences in utilization patterns by disability that warrants additional analysis. The overall predictive power of the two injury models were relatively low, though, compared to the two other sub-analysis which could indicate that additional factors could be at play that would better predict injury visits for this population.

The collinearity analysis found that there were five potential interactions, the same interactions seen in the medical care visit data set. Patient rurality with income in patient zip code quartile and ED trauma level as well as patient primary payer source with income in patient zip code quartile, secondary payer source, and age. Each of these relationships have explanation for the collinearity in practice and have been discussed [69, 73-75]. It was deemed appropriate to include each of these collinearity relationships in the model due to the practical explanation. The Mallow's Criterion analysis showed that the best possible model included 21 of these interactions for each of the injury models specified.

Limitations

Several limitations existed within this research study. First, we were dependent on providers at the time of an ED visit to appropriately code the patient's disability as our identification of our population of interest was done via ICD-9 classification codes. Therefore, we anticipate in the creation of our sample that several false negatives were excluded from our analysis. The HCUP NEDS data is available at the visit identification level and not the patient identification level. Therefore, the same patient may have been included in the analysis multiple times. With this data, it is not possible to follow a patient to see frequency of ED visits or if they have visits occurring as medical care, psychiatric care, and injury care. A majority of the literature review completed as a part of this analysis looked at rate of visits per month or per year. It is impossible with this dissertation to support or refute any of those studies with the visit identification level limitation.

Clinical Implications

The use characteristics of each of the sample sub-analysis, medical care visits, psychiatric care visits, and injury care visits all differed greatly in the severity of treatment, as defined by the procedure code, and patient characteristics. Interventions are needed at the clinical care setting both in the ED and in outpatient care to educate patients and their caregivers/families on the appropriate utilization of the healthcare system. The predictive power of the models developed would allow for targeted interventions specific to disability and demographic characteristics.

It was clearly seen in the data that each of the I/DD disabilities had their own unique characteristics. Previous studies that looked at the overall classification of I/DD may have missed uniqueness amongst each of the sub-disabilities within the I/DD classification. There are also different use profiles for characteristics of the healthcare system both including access to outpatient care settings on the weekend and trauma center classification. These differences can assist outpatient care providers in properly educating their patients with unique education specific to their characteristics and their potential use of the ED.

Policy Implications

The ED is one of the most expensive locations for care delivery in the United States [7-12]. The analysis in this dissertation has found that there are great differences in how the ED was utilized and that individuals who use a public payer for health insurance tend to use the ED for non-emergent care. Education and interventions need to be developed either at the state Medicaid or at the federal Center for Medicare and Medicaid Services (CMS) level. These interventions should be two-fold. First, they

should ensure that patients and their caregivers are given proper education on appropriate utilization of the emergency department. Secondly, resources need to be given to the system to ensure that when patients transition from utilizing the ED for non-emergent care there are additional outpatient services for them to access. Additionally, insurance providers, including the government, should ensure that existing policies and procedures within the organization are not encouraging utilization of the ED by patients when not clinically appropriate.

Both federal and state levels of governments need to review existing programs in place to serve the I/DD population not only as a whole but also for each of the diagnoses that are classified as an I/DD population. The data showed a steady increase in visits with an ASD diagnosis and a steady level of patients with the other three. This population is growing, and additional programs are needed to ensure that this population is appropriately cared for and supported. These supports will not only assist the patients but also the families, guardians, and natural supports caring for this population. Appropriate resources will allow for all members of society to have the opportunity to experience their life goals and ambitions, while minimizing the medical complexity of their diagnosis.

Appendix-Tables

Table 1 Review of Literature

Study Authors	Data Source	Diagnosis	Age	Sample Size	Findings
Berman et al. (2005) [27]	Administrative Data from Singular Hospital	Children with Special Health Care Needs	0 to 4 Years Old	1,012	42.3 visits per 100 child-years
Caicedo (2016) [57]	Chart Review at South Florida Hospital	Children with Special Health Care Needs w. Medical Device Dependency	2 to 21 Years Old	84	0.29 ED visits per patient per month or 3.48 visits per patient per year.
Cohen-Silver et al. (2014) [28]	Chart Review at Tertiary Care Pediatric Center	Autism Spectrum Disorder	0 to 18 Years Old	130	160 visits found in review. 72 visits (44%) occurred outside office hours (8a-4p Mon-Fri) and 51 visits had a high-acuity health issue.
Deavenport-Saman et al. (2016) [29]	Urban, Tertiary Children's Hospital Level 1 Trauma Center	Autism Spectrum Disorder	0 to 22 Years Old	115,443	Diagnosis of ASD had a 0.61 Odds Ratio (OR) controlled against a typically developed population.
Gallaher et al. (2002) [37]	Washington State Medicaid Claims	Developmental Disability	10 to 12 Years Old	1,242	Mean visit of 1 visit per child per year to Emergency Department, controls were 0.5 and below
Marcu et al. (2014) [38]	Florida Medicaid-Two Counties	Children with Special Health Care Needs	1 to 21 Years Old	3,947	0.16 visits per month, on average
McDermott et al. (2015) [39]	South Carolina All-Payer Claims Data	Fragile X, Autism Spectrum Disorder, and Intellectual Disability	15 to 24 Years Old	Fragile X-125; Autism Spectrum Disorder-2,592; Intellectual Disability-10,685	Predicated Probabilities of ED Visit: 24.1% for 15-19 and 17.0% for 20-24 with Fragile X. 21.1% for 15-19 and 19.4% for 20-24 with ASD.

					29.9% for 15-19 and 27.9% for 20-24 with Intellectual Disability.
McDermott et al. (2008) [40]	South Carolina Medicaid Data	Autism Spectrum Disorder	1 to 18 Years Old	138,111	1.47 Relative Rate with ASD for head, face, and neck injuries and 0.54 Relative Rate for strains and sprains
Nazaerth et al. (2016) [41]	Florida, New Jersey, Missouri, Iowa, and Kansas Medicaid Claims Data	Fragile X Syndrome	0 to 17 Years Old	341	34.86% of sample with Fragile X Syndrome used ED
Pollack et al. (2004) [42]	Michigan State Based Data	Children with Special Health Care Needs	0 to 21 years old	10,800	0.55 visits per patient per year
Pollack et al. (2007) [43]	Michigan State Based Data	Children with Special Health Care Needs	0 to 21 years old	24,000	0.089 visits per patient per month
Sarkar et al. (2017) [58]	Ohio Medicaid Assessment Survey	Children with Special Health Care Needs	0 to 17 years old	23,000	2.34 OR (95% CI 1.71-3.22) had ED visit
Youngblade et al. (2012) [44]	Florida State Title XXI Enrollees	Children with Special Health Care Needs	11 to 18 Years Old	11,459	.032 visits per patient per month
Chi et al. (2014) [47]	Healthcare Utilization Project National Emergency Department Sample (HCUP NEDS)	Developmental Disability	3 to 17 Years Old	4,325,309	1.06 OR (95% CI 0.91-1.23) for Non-Traumatic Dental Conditions
Iannuzzi et al. (2015) [11]	HCUPS NEDS	Autism Spectrum Disorder	0 to 18 Years Old	27,518,579	0.27% of encounters had a diagnosis of ASD
Kalb et al. (2012) [45]	HCUP NEDS	Autism Spectrum Disorder	3 to 17 Years Old	13,191	9.13 OR (95% CI 8.61-9.70) for Psychiatric ED Visit with ASD diagnosis
Neumeyer et al. (2015) [46]	HCUP NEDS	Autism Spectrum Disorder	3 to 22 Years Old	28,487,931	0.29% of all ED visits had a diagnosis of

					Autism Spectrum Disorder
Zhang et al. (2017) [59]	HCUP NEDS	Autism Spectrum Disorder	3 to 17 Years Old	36,263,024	1.16 OR (95% CI 1.04, 1.30) for rural residents compared to urban residents
Fiks et al. (2012) [48]	Agency for Healthcare Research and Quality Medical Expenditure Panel Survey (AHRQ MEPS)	Children with Special Health Care Needs	0 to 17 Years Old	2,858	Mean ED expenditure of $64 and overall healthcare expenditure of $2,131.
Kroner et al. (2010) [49]	AHRQ MEPS	Children with Special Health Care Needs	0 to 18 Years Old	8,823	1.99 (95% CI 1.59-2.50) OR of having 2 or more ED visits
Kuo et al. (2015) [50]	AHRQ MEPS	Children with Special Health Care Needs	0 to 18 Years Old	27,775	Visits per year based on severity of CSHCN: Score 0-0.21 Score 1-0.31 Score 2-0.36 Score 3-0.49 Score 4/5-0.50
Liptak et al. (2006) [51]	AHRQ MEPS	Children with Special Health Care Needs	0 to 18 Years Old	2,938	0.37 visits per year in 2000 and 0.26 visits per year in 2001
Newacheck and Kim (2005) [52]	AHRQ MEPS	Children with Special Health Care Needs	0 to 18 Years Old	6,965	0.22 visits per year and 22% of population who used ED had a Special Health Care Need
Romaire et al. (2012) [53]	AHRQ MEPS	Children with Special Health Care Needs	0 to 17 Years Old	9,816	A mean of 0.2 visits per year with a range of 0 to 11.

Liu et al. (2017) [62]	MarketScan Commerical Claims and Encounters Database	Autism Spectrum Disorder	12 to 21 Years Old	87,683	3.1% of the sample used the ED in 2005 and 15.8% used the ED in 2013
Nathenson et al. (2017) [63]	Clinformatics Datam Mart Database	Autism Spectrum Disorder	16 to 23 Years Old	16,338	No variance of ED use by age or time (2000-2013)
Boulet et al. (2009) [12]	National Health Interview Survey	Developmental Disability	3 to 18 Years Old	96,345	10.3% of sample used the ED who had one or more DDs and 16.3% used ED who had three or more DDs
Ghandour et al. (2013) [30]	National Survey of Children's Health	Children with Special Health Care Needs	0 to 5 Years Old	12,820,481	14.5% of the sample used the ED in 2003 and 18.3% in 2007
Javier et al. (2010) [31]	California Health Interview Survey	Children with Special Health Care Needs	0 to 11 Years Old	1,404	30.0% of immigrant's sample used ED and 43.5% of US-born sample used ED
Raphael et al. (2009) [33]	National Survey of Children's Health	Children with Special Health Care Needs	0 to 17 Years Old	35,301	34% had at least 1 ED visit in last year. By race/ethnicity: 31% white, 45.8% black, 38% Hispanic, and 37.3% other.
Rupp et al. (2005) [34]	National Survey of Supplemental Security Income-Children and Families	Children who qualify for Supplemental Security Income	0 to 17 Years Old	791,954	Within the last year: 56% with 0 visits, 16.1% with 1 visit, 10.9% with 2 visits, and 15.6% with 3 or more visits
Weller et al. (2003) [35]	National Health Interview Survey	Children with Special Health Care Needs	5 to 17 Years Old	3,061	23.9% of sample used the ED; 1.28 OR (95% CI 1.05-1.55) for children 12 to 17 years old compared to those 5 to 11 years old

Willitis et al. (2012) [36]	National Survey of Children with Special Health Care Needs	Children with Special Health Care Needs	0 to 18 Years Old	40,273	32.5% of sample used the ED during the study period.

Table 2 I/DD Diagnosis and Matching ICD-9 Codes as Classified

Diagnosis	ICD-9 Code Definition [2]	MedLine Plus Definition
Autism Spectrum Disorder	299.0, 299.00, 299.01, 299.01, 299.1, 299.11, 299.8, 299.80, 299.81, 299.9, 299.90, 299.91	"Autism spectrum disorder (ASD) is a neurological and developmental disorder that begins early in childhood and lasts throughout a person's life. It affects how a person acts and interacts with others, communicates, and learns. It includes what used to be known as Asperger syndrome and pervasive developmental disorders." [78]
Cerebral Palsy	333.71, 343, 343.0, 343.1, 343.2, 343.3, 343.4, 343.8, 343.9	"Cerebral palsy is a group of disorders that affect a person's ability to move and to maintain balance and posture. The disorders appear in the first few years of life. Usually they do not get worse over time. People with cerebral palsy may have difficulty walking. They may also have trouble with tasks such as writing or using scissors. Some have other medical conditions, including seizure disorders or mental impairment." [79]
Intellectual Disabilities-Related Conditions	317, 318, 318.0, 318.1, 318.2, 319, 758, 758.0, 758.1, 758.2, 758.3, 758.31, 758.32, 758.33, 758.39, 758.5, 759.7, 759.81, 759.83, 759.89, 760.71	"Intellectual disability is a condition diagnosed before age 18 that includes below-average intellectual function and a lack of skills necessary for daily living." [80]
Spina Bifida and Other Congenital Anomalies of the Nervous System	740.0, 740.1, 740.2, 741, 741.0, 741.00. 741.01, 741.02, 741.03, 741.9, 741.90, 741.91. 741.92, 741.93, 742.0, 742.1, 742.2, 742.3, 742.4, 742.5, 742.51, 742.53, 742.59, 742.8, 742.9	"Spina bifida is a neural tube defect - a type of birth defect of the brain, spine, or spinal cord. It happens if the spinal column of the fetus doesn't close completely during the first month of pregnancy. This can damage the nerves and spinal cord." [81]

Table 3 Pediatric Specific Diagnosis that are Non-Emergent

Description	3-Digit ICD-9-CM Codes
Asthma	493
Influenza or other viral symptomology	079, 480, 487, 780
Otitis Media	381, 382, 384, 385
Allergic symptoms (including skin)	471, 472, 477, 690, 691, 692, 693, 695
Minor muscular/skeletal or sports injury	840, 841, 842, 843, 844, 845, 846, 847, 848, 910, 911, 913, 914, 915, 916, 917, 918, 919, 923, 924, 955, 956
Preventive, immunization, or well-child care	V03, V04, V05, V06, V07, V20, V67, V68, V69, V70

Adapted from: Ben-Isaac, Schrager [9]

Table 4 Variables Used in Analysis with Values and Univariate Statistical Approach

Conceptual Framework	Variable	Value
Utilization of Health Services	NYU Classification	Non-Emergent Emergent but Primary Care Treatable Emergent but Non-Preventable/Avoidable Emergent but Preventable/Avoidable
Health System-Resources	Admission on Weekend	Admitted Monday-Friday Admitted Saturday-Sunday
Health System-Organization	ED Trauma Level Designation	Not a trauma center Trauma center level I Trauma center level II Trauma center level III Unknown/Missing
Population-Predisposing	Age	Continuous from 3 to 25 and classified into: Preschool 3-5, Elementary 6-11, Middle/High 12-18, Young Adult 19-25
	Diagnosis (Disability)	Binary/Indicator variable for: ASD Cerebral Palsy Intellectual Disability and Related Conditions Spina Bifida and Other Congenital Anomalies of the Nervous System
	Sex	0-Male 1-Female
Population-Enabling	Payer Source #1	1-Medicare 2-Medicaid 3-Private Insurance 4-Self Pay 5-No Charge/Other
	Payer Source #2	1-Medicare 2-Medicaid 3-Private Insurance 4-Self Pay 5-No Charge/Other
	Zip Code Income	1- 0 to 25th percentile 2- 26th to 50th percentile 3- 51st to 75th percentile 4- 76th to 100th percentile
	Patient Rurality	1-“Central” counties of metro areas of >= 1 million population 2-“Fringe” counties of metro areas of >= 1 million population 3-Counties in metro areas of 250,000-999,999 population 4-Counties in metro areas of 50,000-249,999 population 5-Micropolitan counties 6-Not metropolitan or micropolitan counties

Table 5 Multivariate Models Proposed for Analysis Testing of Three Different ED Utilization Scenarios

Model Measurement	Model Components
Medical ED Use Individual Disability	Medical Event (Per NYU Classification) = Hospital Trauma Status + Weekend Admission + Age + Sex + Patient Rurality + Payer 1 + Payer 2 + Median Zip Code Income + Year of Data + ASD Indicator Variable + Cerebral Palsy Indicator Variable + ID Indicator Variable + Spina Bifida Indicator Variable + Survey Weight
Medical ED Use Total Disability	Medical Event (Per NYU Classification) = Hospital Trauma Status + Weekend Admission + Age + Sex + Patient Rurality + Payer 1 + Payer 2 + Median Zip Code Income + Year of Data + Total Count of I/DD + Survey Weight
Psychiatric ED Use Individual Disability	Psychiatric Event = Hospital Trauma Status + Weekend Admission + Age + Sex + Patient Rurality + Payer 1 + Payer 2 + Median Zip Code Income + Year of Data + ASD Indicator Variable + Cerebral Palsy Indicator Variable + ID Indicator Variable + Spina Bifida Indicator Variable + Survey Weight
Psychiatric ED Use Total Disability	Psychiatric Event = Hospital Trauma Status + Weekend Admission + Age + Sex + Patient Rurality + Payer 1 + Payer 2 + Median Zip Code Income + Year of Data + Total Count of I/DD + Survey Weight
Injury ED Use Individual Disability	Injury Event Hospital = Trauma Status + Weekend Admission + Age + Sex + Patient Rurality + Payer 1 + Payer 2 + Median Zip Code Income + Year of Data + ASD Indicator Variable + Cerebral Palsy Indicator Variable + ID Indicator Variable + Spina Bifida Indicator Variable + Survey Weight
Injury ED Use Total Disability	Injury Event Hospital = Trauma Status + Weekend Admission + Age + Sex + Patient Rurality + Payer 1 + Payer 2 + Median Zip Code Income + Year of Data + Total Count of I/DD + Survey Weight

Table 6 Sample and Weighted Sample Size for Visits of children 3-25 in the HCUP NEDS by year

Year	Pediatric & Young Adult Sample Size	Weighted Sample Size	Final Size	Final Weighted Sample Size
2009	8,286,381	36,921,460	57,733	229,015
2010	7,817283	35,194,012	55,451	227,647
2011	7,908,473	35,984,116	61,679	261,509
2012	8,503,765	36,836,223	68,513	275,051
2013	7,863,536	35,873,978	67,510	288,243
2014	8,057,461	35,850,992	75,746	317,024
Total	48,436,899	216,660,781	386,632	1,598,489

Table 7 Sample Size and Weight Count by Year and Diagnosis

Year	Autism Spectrum Disorder		Cerebral Palsy		Intellectual Disabilities-Related Conditions		Spina Bifida and Other Congenital Anomalies of the Nervous System	
	Sample Size	Weighted Count (% of sample)	Sample Size	Weighted Count (% of sample)	Sample Size	Weighted Count (% of sample)	Sample Size	Weighted Count (% of sample)
2009	18,204	81,504 (0.22%)	15,429	68,774 (0.19%)	20,920	93,896 (0.25%)	3,180	14,458 (0.04%)
2010	19,224	87,495 (0.25%)	14,316	65,460 (0.19%)	18,800	86,340 (0.25%)	3,111	14,552 (0.04%)
2011	23,438	109,552 (.30%)	15,228	72,965 (0.20%)	19,921	94,236 (0.26%)	3,092	15,074 (0.04%)
2012	27,579	121,796 (0.33%)	15,936	71,454 (0.19%)	21,622	96,779 (0.26%)	3,376	15,234 (0.04%)
2013	28,880	133,925 (0.37%)	15,292	72,281 (0.20%)	20,096	94,725 (0.26%)	3,242	15,503 (0.04%)
2014	35,171	160,629 (0.45%)	15,723	72,206 (0.20%)	21,227	98,170 (0.27%)	3,625	17,008 (0.05%)
TOTAL	152,496	649,901	91,924	423,140	122,586	564,146	19,626	91,829

Table 8 Correlation Among Disability Overall

	Autism	Cerebral Palsy	Intellectual Disability	Spina Bifida
Autism	1.000	-0.482****	-0.503****	-0.206****
Cerebral Palsy	-0.482****	1.000	-0.182****	-0.058****
Intellectual Disability	-0.503****	-0.182****	1.000	-0.122****
Spina Bifida	-0.206****	-0.058****	-0.122****	1.000

* p-value <.05
** p-value <.01
*** p-value <.001
**** p-vale <.0001

Table 9 Top 10 Primary Diagnosis for Each Disability Diagnosis Across all Six Years for Medical Care Visits

Primary Visit Diagnosis (ICD-9)								
Top 10	Autism Spectrum Disorder		Cerebral Palsy		Intellectual Disabilities		Spina Bifida & Other Congenital Anomalies	
1	Epilepsy, unspecified (345.90)	4,269 (4.87%)	Epilepsy, unspecified (345.90)	5,541 (7.20%)	Pneumonia, Organism Unspecified (486)	4,855 (5.93%)	Urinary Tract Infection (599.0)	1,318 (7.69%)
2	Other convulsions (780.39)	3,913 (4.46%)	Pneumonia, Organism Unspecified (486)	4,140 (5.38%)	Epilepsy, unspecified (345.90)	4,091 (4.99%)	Headache (784.0)	941 (5.49%)
3	Upper Respiratory Infection (465.9)	3,517 (4.01%)	Other convulsions (780.39)	3,092 (4.02%)	Upper Respiratory Infection (465.9)	2,463 (3.01%)	Mechanical Complication with Nervous System Device, Implant, & Graft (996.2)	886 (5.17%)
4	Unspecified Otitis Media (382.9)	3,109 (3.55%)	Upper Respiratory Infection (465.9)	2,134 (2.77%)	Other convulsions (780.39)	2,355 (2.88%)	Epilepsy, unspecified (345.90)	672 (3.92%)
5	Fever, Unspecified (780.60)	2,703 (3.08%)	Fever, Unspecified (780.60)	2,049 (2.66%)	Fever, Unspecified (780.60)	1,971 (2.41%)	Pneumonia, Organism Unspecified (486)	497 (2.90%)
6	Constipation, Unspecified (564.00)	2,306 (2.63%)	Pneumonitis due to solid & liquid (507.0)	2,042 (2.65%)	Urinary Tract Infection (599.0)	1,639 (2.00%)	Other convulsions (780.39)	478 (2.79%)
7	Vomiting (787.03)	2,238 (2.55%)	Urinary Tract Infection (599.0)	1,734 (2.25%)	Pneumonitis due to solid & liquid (507.0)	1,580 (1.93%)	Hearing Loss (389)	353 (2.06%)
8	Acute Pharyngitis (462)	1,869 (2.13%)	Attention to Artificial Opening-GI (V55.1)	1,698 (2.21%)	Vomiting (787.03)	1,468 (1.79%)	Pneumonitis due to solid & liquid (507.0)	330 (1.93%)
9	Pneumonia, Organism Unspecified (486)	1,860 (2.12%)	Grand Mal Status (345.3)	1,455 (1.89%)	Dehydration (276.51)	1,423 (1.74%)	Grand Mal Status (345.3)	317 (1.85%)
10	Abdomen Symptoms (789.00)	1,769 (2.02%)	Hearing Loss (389)	1,425 (1.85%)	Constipation, Unspecified (564.00)	1,343 (1.64%)	Fever, Unspecified (780.60)	277 (1.62%)
Rest	Other Diagnosis	60,189 (68.9%)	Other Diagnosis	51,727 (67.1%)	Other Diagnosis	58,621 (71.9%)	Other Diagnosis	11,068 (64.9%)

*ICD-9 Dictionary Source [82]

Table 10 Top 10 Primary Procedures for Each Disability Diagnosis Across all Six Years for Medical Care Visits

Primary Procedure Preformed (CPT Code)								
Top 10	Autism Spectrum Disorder		Cerebral Palsy		Intellectual Disabilities		Spina Bifida & Other Congenital Anomalies	
1	Emergency Department Visit Level 3 (99283)	16,067 (30.4%)	Emergency Department Visit Level 3 (99283)	7,822 (22.8%)	Emergency Department Visit Level 3 (99283)	9,442 (25.6%)	Emergency Department Visit Level 3 (99283)	1,312 (21.2%)
2	Emergency Department Visit Level 2 (99282)	8,193 (15.5%)	Emergency Department Visit Level 4 (99284)	5,994 (17.5%)	Emergency Department Visit Level 4 (99284)	6,052 (16.4%)	Emergency Department Visit Level 4 (99284)	962 (15.5%)
3	Emergency Department Visit Level 4 (99284)	7,852 (14.9%)	Emergency Department Visit Level 2 (99282)	2,957 (8.6%)	Emergency Department Visit Level 2 (99282)	3,984 (10.8%)	Emergency Department Visit Level 2 (99282)	524 (8.5%)
4	Emergency Department Visit Level 1 (99281)	2,425 (4.6%)	Emergency Department Visit Level 5 (99285)	2,518 (7.3%)	Emergency Department Visit Level 5 (99285)	2,458 (6.7%)	Computed tomography, head or brain (70450)	394 (6.4%)
5	Emergency Department Visit Level 5 (99285)	2,377 (4.5%)	Vascular Access Procedure (36415)	1,631 (4.8%)	Vascular Access Procedure (36415)	1,503 (4.1%)	Emergency Department Visit Level 5 (99285)	354 (5.7%)
6	Vascular Access Procedure (36415)	1,683 (3.2%)	Computed tomography, head or brain (70450)	1,070 (3.1%)	Emergency Department Visit Level 1 (99281)	1,111 (3.0%)	Vascular Access Procedure (36415)	312 (5.0%)
7	Computed tomography, head or brain (70450)	1,063 (2.0%)	Emergency Department Visit Level 1 (99281)	860 (2.5%)	Chest X-Ray (71020)	799 (2.2%)	Emergency Department Visit Level 1 (99281)	158 (2.6%)
8	Chest X-Ray (71020)	898 (1.7%)	Chest X-Ray (71020)	582 (1.7%)	Computed tomography, head or brain (70450)	725 (2.0%)	Therapeutic, prophylactic, or diagnostic injection-drip (96374)	111 (1.8%)
9	Metabolic Panel (80053)	533 (1.0%)	Change of Gastrostomy Tube (43760)	544 (1.6%)	Metabolic Panel (80053)	449 (1.2%)	Therapeutic, prophylactic, or diagnostic injection-subacute (96372)	83 (1.3%)
10	Therapeutic, prophylactic, or diagnostic injection-drip (96374)	449 (0.9%)	Therapeutic, prophylactic, or diagnostic injection-drip (96374)	518 (1.5%)	Therapeutic, prophylactic, or diagnostic injection-drip (96374)	398 (1.1%)	Urinalysis (81001)	66 (1.1%)
Rest	Other Procedure	11,459 (21.4%)	Other Procedure	9,808 (28.6%)	Other Procedure	9,907 (26.9%)	Other Procedure	1908 (30.9%)

*CPT Code Definition Source [72]

Table 11 Top 10 Primary Diagnosis Codes by Year across all Disability for Medical Care Visits

Primary Visit Diagnosis (ICD-9)						
Top 10	2009-2010		2011-2012		2013-2014	
1	Epilepsy, unspecified (345.90)	4,240 (6.1%)	Epilepsy, unspecified (345.90)	4,231 (5.3%)	Epilepsy, unspecified (345.90)	4,047 (4.7%)
2	Pneumonia, Organism Unspecified (486)	3,382 (4.9%)	Pneumonia, Organism Unspecified (486)	3,341 (4.2%)	Other convulsions (780.39)	3,116 (3.6%)
3	Other convulsions (780.39)	2,831 (4.1%)	Other convulsions (780.39)	2,976 (3.8%)	Upper Respiratory Infection (465.9)	2,969 (3.4%)
4	Upper Respiratory Infection (465.9)	2,244 (3.2%)	Upper Respiratory Infection (465.9)	2,472 (3.1%)	Pneumonia, Organism Unspecified (486)	2,860 (3.3%)
5	Fever, Unspecified (780.60)	1,976 (2.9%)	Fever, Unspecified (780.60)	2,148 (2.7%)	Fever, Unspecified (780.60)	2,317 (2.7%)
6	Urinary Tract Infection (599.0)	1,601 (2.3%)	Unspecified Otitis Media (382.9)	1,758 (2.2%)	Constipation, Unspecified (564.00)	2,026 (2.3%)
7	Vomiting (787.03)	1,466 (2.1%)	Urinary Tract Infection (599.0)	1,650 (2.1%)	Vomiting (787.03)	1,891 (2.2%)
8	Unspecified Otitis Media (382.9)	1,420 (2.1%)	Vomiting (787.03)	1,590 (2.0%)	Unspecified Otitis Media (382.9)	1,873 (2.2%)
9	Dehydration (276.51)	1,110 (1.6%)	Abdominal Pain (789.00)	1,489 (1.9%)	Urinary Tract Infection (599.0)	1,779 (2.1%)
10	Constipation, Unspecified (564.00)	1,085 (1.57%)	Dehydration (276.51)	1,309 (1.7%)	Abdominal Pain (789.00)	1,491 (1.7%)
Rest	Other Diagnosis	47,940 (69.1%)	Other Diagnosis	56,289 (71.1%)	Other Diagnosis	62,619 (71.9%)

*ICD-9 Dictionary Source [82]

Table 12 Top 10 Primary Procedure Codes by Year across all Disability for Medical Care Visits

Primary Procedure Preformed (CPT Code)						
Top 10	2009-2010		2011-2012		2013-2014	
1	Emergency Department Visit Level 3 (99283)	8,379 (26.7%)	Emergency Department Visit Level 3 (99283)	11,033 (27.6%)	Emergency Department Visit Level 3 (99283)	13,228 (26.4%)
2	Emergency Department Visit Level 4 (99284)	4,883 (15.6%)	Emergency Department Visit Level 4 (99284)	6,554 (16.4%)	Emergency Department Visit Level 4 (99284)	7,853 (15.7%)
3	Emergency Department Visit Level 2 (99282)	4,401 (14.0%)	Emergency Department Visit Level 2 (99282)	4,628 (11.6%)	Emergency Department Visit Level 2 (99282)	5,895 (11.8%)
4	Emergency Department Visit Level 5 (99285)	1,705 (5.4%)	Emergency Department Visit Level 5 (99285)	2,333 (5.8%)	Emergency Department Visit Level 5 (99285)	2,975 (5.9%)
5	Vascular Access Procedure (36415)	1,288 (4.1%)	Vascular Access Procedure (36415)	1,806 (4.5%)	Emergency Department Visit Level 1 (99281)	1,800 (3.6%)
6	Emergency Department Visit Level 1 (99281)	1,235 (3.9%)	Emergency Department Visit Level 1 (99281)	1,283 (3.2%)	Vascular Access Procedure (36415)	1,673 (3.3%)
7	Computed tomography, head or brain (70450)	1,024 (3.3%)	Computed tomography, head or brain (70450)	972 (2.4%)	Computed tomography, head or brain (70450)	992 (2.0%)
8	Chest X-Ray (71020)	701 (2.2%)	Chest X-Ray (71020)	664 (1.7%)	Chest X-Ray (71020)	830 (1.7%)
9	Therapeutic, prophylactic, or diagnostic injection-drip (96374)	384 (1.2%)	Therapeutic, prophylactic, or diagnostic injection-drip (96374)	508 (1.3%)	Metabolic Panel (80053)	782 (1.6%)
10	Chest X-Ray (71010)	296 (0.9%)	Metabolic Panel (80053)	402 (1.0%)	Computed tomography, abdomen and pelvis (74177)	480 (1.0%)
Rest	Other Procedure	7,107 (22.6%)	Other Procedure	9,808 (24.5%)	Other Procedure	13,600 (27.1%)

*CPT Code Definition Source [72]

Table 13 Frequency of Medical Visits by Year and Severity (NYU Classification)

Year	Non-Emergent	Emergent but Primary Care Treatable	ED Treatment Need-Preventable	ED Treatment Need-Non-Preventable	Non-Classified
2009	12,736 (35.9%)	5,463 (15.4%)	2,406 (6.8%)	2,639 (7.4%)	12,284 (34.6%)
2010	11,444 (33.9%)	5,205 (15.4%)	2,048 (6.1%)	2,681 (7.9%)	9,705 (31.2%)
2011	13,241 (35.1%)	5,996 (15.9%)	2,110 (5.6%)	3,032 (8.0%)	13,325 (35.3%)
2012	14,771 (35.5%)	6,740 (16.2%)	2,356 (5.7%)	3,354 (8.1%)	14,451 (34.7%)
2013	15,287 (36.5%)	6,756 (16.1%)	2,021 (4.8%)	3,494 (8.3%)	14,349 (34.2%)
2014	16,442 (36.6%)	7,384 (16.4%)	1,975 (4.4%)	3,853 (8.6%)	15,297 (34.1%)

Table 14 Frequency of Medical Visits by I/DD Diagnosis and Severity (NYU Classification)

Disability	Non-Emergent	Emergent but Primary Care Treatable	ED Treatment Need-Preventable	ED Treatment Need-Non-Preventable	Non-Classified
Autism Spectrum Disorder	39,094 (44.6%)	15,851(18.1%)	5,741 (6.6%)	2,676 (3.1%)	21,315 (24.3%)
Cerebral Palsy	22,152 (28.8%)	10,429 (13.6%)	5,150 (6.7%)	6,921 (9.0%)	32,289 (42.0%)
Intellectual Disabilities	24,409 (29.8%)	12,810 (15.6%)	6,341 (7.7%)	8,013 (9.8%)	30,340 (37.0%)
Spina Bifida & Other Congenital Anomalies	4,439 (25.9%)	1,669 (9.7%)	1,040 (6.1%)	1,380 (8.1%)	8,605 (50.2%)

Table 15 Bivariate Results of Medical Care Visits Analysis

Variable	Value	Count (%) of Non-Emergent Visit	Count (%) of Emergent Visit	P-Value
Admission on Weekend	Admitted Monday-Friday	59,563 (71.0%)	110,113 (72.6%)	<.001
	Admitted Saturday-Sunday	24,315 (29.0%)	41,472 (27.4%)	
ED Trauma Level	Not Trauma Center	31,722 (37.8%)	51,224 (33.8%)	<.001
	Trauma Level 1	20,072 (23.9%)	44,752 (29.5%)	
	Trauma Level 2	8,878 (10.6%)	15,285 (10.1%)	
	Trauma Level 3	5,239 (6.2%)	9,025 (6.0%)	
	Unclassified	17,990 (21.4%)	31,319 (20.7%)	
Age	Preschool 3-5	18,839 (22.5%)	26,252 (17.3%)	<.001
	Elementary 6-11	26,053 (31.1%)	39,770 (26.2%)	
	Middle/High 12-18	20,686 (24.7%)	40,784 (26.9%)	
	Young Adult 19-25	18,323 (21.8%)	44,799 (29.6%)	
Sex	Female	28,534 (34.0%)	58,018 (38.3%)	<.001
	Male	55,348 (66.0%)	93,569 (61.7%)	
Payer Source #1	Medicare	2,981 (3.6%)	7,278 (4.8%)	<.001
	Medicaid	51,851 (61.9%)	91,089 (60.2%)	
	Private Insurance	22,964 (27.4%)	42,912 (28.3%)	
	Self-Pay	2,705 (3.2%)	3,787 (2.5%)	
	Other	3,296 (3.9%)	6,356 (4.2%)	
Payer Source #2	Medicare	460 (2.4%)	1,068 (2.9%)	<.001
	Medicaid	9,401 (48.3%)	19,482 (52.2%)	
	Private Insurance	3,275 (16.8%)	5,453 (14.6%)	
	Self-Pay	5,393 (27.7%)	9,773 (26.2%)	
	Other	931 (4.8%)	1,532 (4.1%)	
Zip Code Income Quarterlies	0 to 25th Percentile	24,784 (30.1%)	43,274 (29.1%)	<.001
	26th to 50th Percentile	22,766 (27.6%)	40,184 (27.0%)	
	51st to 75th Percentile	19,317 (23.4%)	36,126 (24.3%)	
	76th to 100th Percentile	15,561 (18.9%)	29,179 (19.6%)	
Patient Rurality	Central counties of metro area >=1 Million Population	25,855 (30.8%)	48,757 (32.2%)	<.001
	Fringe counties of metro area >=1 Million Population	18,742 (22.3%)	34,205 (22.6%)	
	Metro County 250,000 to 999,999 Population	19,229 (22.9%)	33,484 (22.1%)	
	Metro County of 50,000 to 249,999 Population	7,485 (8.9%)	13,160 (8.7%)	
	Micropolitan	7,894 (9.4%)	13,593 (9.0%)	
	Non-Metro/Micro County	4,405 (5.3%)	7,885 (5.2%)	

Table 16 Correlation Among Disability for Medical Care

	Autism	Cerebral Palsy	Intellectual Disability	Spina Bifida
Autism	1.000	-0.489****	-0.454****	-0.206****
Cerebral Palsy	-0.489****	1.000	-0.195****	-0.095****
Intellectual Disability	-0.454****	-0.195****	1.000	-0.136****
Spina Bifida	-0.206****	-0.095****	-0.136****	1.000

* p-value <.05
** p-value <.01
*** p-value <.001
**** p-vale <.0001

Table 17 Logistic Regression Results for Medical Care Visits Individual Disability

Variable	Comparison	Odds Ratio	OR 95% CI
Admission on Weekend	Weekend	1.052****	1.032-1.072
ED Trauma Level	Not Trauma Center	Ref	
	Trauma Level 1	1.263****	1.229-1.297
	Trauma Level 2	1.017	0.983-1.052
	Trauma Level 3	1.042	1.000-1.086
	Unclassified	0.946****	0.923-0.970
Age	Preschool 3-5	Ref	
	Elementary 6-11	1.108****	1.081-1.136
	Middle/High 12-18	1.344****	1.310-1.379
	Young Adult 19-25	1.587****	1.544-1.631
Sex	Male	0.985	0.966-1.004
Payer Source #1	Medicaid	Ref	
	Medicare	1.033	0.984-1.085
	Private Insurance	1.100****	1.076-1.124
	Self-Pay	0.810****	0.768-0.854
	Other	1.134****	1.084-1.186
Payer Source #2	Government Insurance	Ref	
	Other/None	0.979	0.952-1.008
Income in Zip Code	0 to 25th Percentile	Ref	
	26th to 50th Percentile	1.017	0.993-1.041
	51st to 75th Percentile	1.063****	1.037-1.090
	76th to 100th Percentile	1.069****	1.039-1.100
Patient Rurality	Central County (>= 1 Million Population)	Ref	
	Fringe County (>= 1 Million Population	1.004	0.979-1.029
	Large Metro County (250,000 to 999,999 Population)	0.960**	0.937-0.984
	Small Metro County (50,000 to 249,999 Population)	0.992	0.959-1.027
	Micropolitan	1.000	0.966-1.034
	Non-Metro/Micro County	1.019	0.977-1.063
Autism	Disability Present	0.947**	0.915-0.981
Cerebral Palsy	Disability Present	0.554****	0.536-0.572
Intellectual Disability	Disability Present	0.586****	0.568-0.605
Spina Bifida	Disability Present	0.492****	0.471-0.515
Year	2009	Ref	
	2010	1.116****	1.080-1.152
	2011	1.038*	1.006-1.072
	2012	1.054***	1.022-1.088
	2013	1.022	0.991-1.054
	2014	1.045**	1.014-1.077

* p-value <.05
** p-value <.01
*** p-value <.001
**** p-vale <.0001

Table 18 Logistic Regression Results for Medical Care Visits Disability Total

Variable	Comparison	Odds Ratio	OR 95% CI
Admission on Weekend	Weekend	1.056****	1.036-1.076
ED Trauma Level	Not Trauma Center	Ref	
	Trauma Level 1	1.331****	1.296-1.367
	Trauma Level 2	1.028	0.994-1.063
	Trauma Level 3	1.016	0.976-1.059
	Unclassified	0.926****	0.903-0.949
Age	Preschool 3-5	Ref	
	Elementary 6-11	1.079****	1.052-1.106
	Middle/High 12-18	1.362****	1.328-1.397
	Young Adult 19-25	1.744****	1.698-1.792
Sex	Male	0.867****	0.852-0.883
Payer Source #1	Medicaid	Ref	
	Medicare	1.035	0.986-1.087
	Private Insurance	1.066****	1.044-1.089
	Self-Pay	0.786****	0.746-0.828
	Other	1.123****	1.074-1.174
Payer Source #2	Government Insurance	Ref	
	Other/None	0.965*	0.938-0.992
Income in Zip Code	0 to 25th Percentile	Ref	
	26th to 50th Percentile	1.017	0.994-1.041
	51st to 75th Percentile	1.062****	1.036-1.089
	76th to 100th Percentile	1.050***	1.021-1.081
Patient Rurality	Central County (>= 1 Million Population)	Ref	
	Fringe County (>= 1 Million Population	0.997	0.973-1.022
	Large Metro County (250,000 to 999,999 Population)	0.952****	0.929-0.976
	Small Metro County (50,000 to 249,999 Population)	0.999	0.966-1.034
	Micropolitan	1.004	0.971-1.038
	Non-Metro/Micro County	1.058**	1.015-1.104
Number of I/DD Disabilities	1 Disability	Ref	
	2 Disability	1.825****	1.767-1.884
	3 or 4 Disability	2.747****	2.422-3.115
Year	2009	Ref	
	2010	1.103****	1.068-1.139
	2011	0.993	0.962-1.025
	2012	1.003	0.973-1.034
	2013	0.958**	0.930-0.988
	2014	0.967*	0.938-0.996

* p-value <.05
** p-value <.01
*** p-value <.001
**** p-vale <.0001

Table 19 Collinearity Analysis of Medical Care Visits-Conceptual Framework Variables

Variable Interaction	Chi-Square	Lambda Symmetric	Uncertainty Coefficient Symmetric
Admission on Weekend x Sex	5.0444*	0.0000	0.0000
Admission on Weekend x Payer Source #1	27.8047****	0.0000	0.0001
Admission on Weekend x Payer Source #2	1.6569	0.0000	0.0000
Admission on Weekend x Income in Zip Code	7.8870*	0.0000	0.0000
Admission on Weekend x ED Trauma Level	126.6603****	0.0000	0.0003
Admission on Weekend x Patient Rurality	44.6375****	0.0000	0.0001
Admission on Weekend x Age	280.974****	0.0000	0.0006
Sex x Payer Source #1	217.8202****	0.0000	0.0005
Sex x Payer Source #2	27.0210****	0.0000	0.0001
Sex x Income in Zip Code	39.4435****	0.0000	0.0001
Sex x ED Trauma Level	100.6032****	0.000	0.0002
Sex x Patient Rurality	71.6913****	0.0000	0.0001
Sex x Age	1,658.4614****	0.0217	0.0034
Payer Source #1 x Payer Source #2	27,430.9750****	0.0620	0.0705
Payer Source #1 x Income in Zip Code	19,084.8513****	0.0708	0.0339
Payer Source #1 x ED Trauma Level	1,329.5838****	0.0000	0.0023
Payer Source #1 x Patient Rurality	4,156.8594*****	0.0038	0.0063
Payer Source #1 x Age	26,170.5211****	0.0417	0.0419
Payer Source #2 x Income in Zip Code	281.4370****	0.0000	0.0007
Payer Source #2 x ED Trauma Level	584.0589****	0.0000	0.0013
Payer Source #2 x Patient Rurality	2,831.5348****	0.0099	0.0062
Payer Source #2 x Age	3,277.4298****	0.0268	0.0074
Income in Zip Code x ED Trauma Level	2,084.8769****	0.0096	0.0032
Income in Zip Code x Patient Rurality	43,395.2863****	0.0819	0.0663
Income in Zip Code x Age	262.0290****	0.0014	0.0004
ED Trauma Level x Patient Rurality	26,726.9684****	0.0343	0.0348
ED Trauma Level x Age	3769.7160****	0.0199	0.0058
Patient Rurality x Age	294.5382****	0.0017	0.0004

* p-value <.05
** p-value <.01
*** p-value <.001
**** p-vale <.0001

Table 20 Collinearity Analysis of Medical Care Visits-Disability Variables

Variable Interaction	Chi-Square	Lambda Symmetric	Uncertainty Coefficient Symmetric
ASD x Admission on Weekend	46.7439****	0.0000	0.0002
ASD x Sex	14,854.4183****	0.0000	0.0501
ASD x Payer Source #1	2,355.7193****	0.0000	0.0062
ASD x Payer Source #2	372.7005****	0.0000	0.0015
ASD x Income in Zip Code	564.5543****	0.0000	0.0012
ASD x ED Trauma Level	1,820.3160****	0.0000	0.0037
ASD x Patient Rurality	462.0555****	0.0000	0.0009
Cerebral Palsy x Admission on Weekend	69.7229****	0.0000	0.0002
Cerebral Palsy x Sex	2,815.4760****	0.0000	0.0092
Cerebral Palsy x Payer Source #1	962.4468****	0.0000	0.0025
Cerebral Palsy x Payer Source #2	116.4284****	0.0000	0.0005
Cerebral Palsy x Income in Zip Code	261.3856****	0.0000	0.0006
Cerebral Palsy x ED Trauma Level	1,139.7920****	0.0000	0.0023
Cerebral Palsy x Patient Rurality	241.3508****	0.0000	0.0004
Intellectual Disability x Admission on Weekend	2.6835	0.0000	0.0000
Intellectual Disability x Sex	2,884.4799****	0.0000	0.0093
Intellectual Disability x Payer Source #1	1,904.6777****	0.0006	0.0047
Intellectual Disability x Payer Source #2	389.9267****	0.0000	0.0016
Intellectual Disability x Income in Zip Code	27.1384****	0.0000	0.0001
Intellectual Disability x ED Trauma Level	498.9776****	0.0000	0.0010
Intellectual Disability x Patient Rurality	993.0679****	0.0000	0.0018
Spina Bifida x Admission on Weekend	25.5333****	0.0000	0.0001
Spina Bifida x Sex	1,719.7382****	0.0049	0.0077
Spina Bifida x Payer Source #1	103.7996****	0.0000	0.0003
Spina Bifida x Payer Source #2	26.4531****	0.0000	0.0002
Spina Bifida x Income in Zip Code	31.4708****	0.0000	0.0001
Spina Bifida x ED Trauma Level	1,432.5152****	0.0130	0.0034
Spina Bifida x Patient Rurality	64.8446****	0.0000	0.0001

* p-value <.05
** p-value <.01
*** p-value <.001
**** p-vale <.0001

Table 21 Top 10 Primary Diagnosis for Each Disability Across All Six Years for Psychiatric Visits

Primary Visit Diagnosis (ICD-9)								
Top 10	Autism Spectrum Disorder		Cerebral Palsy		Intellectual Disabilities		Spina Bifida & Other Congenital Anomalies	
1	Autistic Disorder, current/active state (299.00)	6,801 (21.07%)	Pick's Disease (311)	281 (10.16%)	Unspecified Episodic Mood Disorder (296.90)	2,736 (11.44%)	Unspecified Episodic Mood Disorder (296.90)	39 (10.86%)
2	Unspecified Episodic Mood Disorder (296.90)	2,837 (8.79%)	Unspecified Episodic Mood Disorder (296.90)	228 (8.24%)	Other Pervasive Development Disorder (299.80)	1,605 (6.71%)	Pick's Disease (311)	31 (8.64%)
3	Other Pervasive Development Disorder (299.80)	2,125 (6.58%)	Unspecified Special Symptom (307.9)	194 (7.01%)	Schizoaffective Disorder (295.70)	1,399 (5.85%)	Anxiety State, Unspecified (300.00)	28 (7.80%)
4	Unspecified Disturbance of Conduct (312.9)	1,879 (5.82%)	Anxiety State, Unspecified (300.00)	180 (6.51%)	Unspecified Psychosis (298.9)	1,385 (5.79%)	Unspecified Disturbance of Conduct (312.9)	22 (6.13%)
5	Pick's Disease (311)	1,528 (4.73%)	Unspecified Psychosis (298.9)	165 (5.97%)	Impulse Control Disorder (312.30)	1,261 (5.27%)	Post-concussion Syndrome (310.2)	19 (5.29%)
6	Bipolar Disorder (296.80)	1,459 (4.52%)	Unspecified Disturbance of Conduct (312.9)	142 (5.13%)	Unspecified Disturbance of Conduct (312.9)	1,123 (4.70%)	Unspecified Psychosis (298.9)	17 (4.74%)
7	Unspecified Psychosis (298.9)	1,254 (3.88%)	Other Pervasive Development Disorder (299.80)	131 (4.74%)	Pick's Disease (311)	1,043 (4.36%)	Unspecified Special Symptom (307.9)	14 (3.90%)
8	Unspecified Special Symptom (307.9)	1,200 (3.72%)	Schizoaffective Disorder (295.70)	66 (2.39%)	Intermittent Explosive Disorder (312.34)	914 (3.82%)	**	**
9	ADHD (314.01)	964 (2.99%)	Explosive Personality Disorder (301.3)	65 (2.35%)	Unspecified Intellectual Disorder (319)	889 (3.72%)	**	**
10	Anxiety State, Unspecified (300.00)	949 (2.94%)	Major Depressive Affective Disorder (296.20)	59 (2.13%)	Autistic Disorder, current/active state (299.00)	857 (3.58%)	**	**
Total	Other Diagnosis	20,996/ 65.04%	Other Diagnosis	1,511/ 54.63%	Other Diagnosis	13,212/ 55.24%	Other Diagnosis	170/ 47.36%

*ICD-9 Dictionary Source [83]

** Sample Size Smaller than Reportable per HCUP Data Use Agreement

Table 22 Top 10 Primary Procedures for Each Disability Diagnosis Across All Six Years for Psychiatric Visits

Primary Procedure Preformed (CPT Code)								
Top 10	Autism Spectrum Disorder		Cerebral Palsy		Intellectual Disabilities		Spina Bifida & Other Congenital Anomalies	
1	Emergency Department Visit Level 3 (99283)	3,974 (22.86%)	Emergency Department Visit Level 4 (99284)	251 (21.27%)	Emergency Department Visit Level 3 (99283	2,319 (22.95%)	Emergency Department Visit Level 4 (99284)	24 (21.43%)
2	Emergency Department Visit Level 5 (99285)	3,629 (20.87%)	Emergency Department Visit Level 5 (99285)	230 (19.49%)	Emergency Department Visit Level 4 (99284)	2,240 (22.17%)	Emergency Department Visit Level 3 (99283)	19 (16.96%)
3	Emergency Department Visit Level 4 (99284)	3,591 (20.65%)	Emergency Department Visit Level 3 (99283)	207 (17.54%)	Emergency Department Visit Level 5 (99285)	2,226 (22.03%)	Emergency Department Visit Level 5 (99285)	16 (14.29%)
4	Emergency Department Visit Level 2 (99282)	1,037 (5.96%)	Vascular Access Procedure (36415)	83 (7.03%)	Vascular Access Procedure (36415)	524 (5.19%)	**	**
5	Vascular Access Procedure (36415)	812 (4.67%)	Emergency Department Visit Level 2 (99282)	80 (6.78%)	Psychiatric Diagnostic Evaluation (90801)	400 (3.96%)	**	**
6	Emergency Department Visit Level 1 (99281)	456 (2.62%)	Metabolic Panel (80053)	37 (3.14%)	Emergency Department Visit Level 2 (99282)	390 (3.86%)	**	**
7	Psychiatric Diagnostic Evaluation (90801)	418 (2.40%)	Computed tomography, head or brain (70450)	28 (2.37%)	Drug Screen (80101)	324 (3.20%)	**	**
8	Drug Screen (80101)	341 (1.96%)	Emergency Department Visit Level 1 (99281)	28 (2.37%)	Metabolic Panel (80053)	243 (2.40%)	**	**
9	Metabolic Panel (80053)	297 (1.71%)	Psychiatric Diagnostic Evaluation (90801)	24 (2.03%)	Emergency Department Visit Level 1 (99281)	131 (1.30%)	**	**
10	Therapeutic, prophylactic, or diagnostic injection-subacute (96372)	218 (1.25%)	Drug Screen (80101)	20 (1.69%)	Observation Services (G0378)	115 (1.14%)	**	**
Total		14,773/ 84.95%		988/ 83.71%		8912/ 88.2%		59/ 52.68%

*CPT Code Definition Source [72]

** Sample Size Smaller than Reportable per HCUP Data Use Agreement

Table 23 Top 10 Primary Diagnosis Codes by Year across all Disability for Psychiatric Visits

Primary Visit Diagnosis (ICD-9)						
Top 10	2009-2010		2011-2012		2013-2014	
1	Autistic Disorder, current/active state (299.00)	1,688 (11.49%)	Autistic Disorder, current/active state (299.00)	1,990 (11.19%)	Autistic Disorder, current/active state (299.00)	3,123 (14.50%)
2	Unspecified Episodic Mood Disorder (296.90)	1,113 (7.58%)	Unspecified Episodic Mood Disorder (296.90)	1,848 (10.39%)	Unspecified Episodic Mood Disorder (296.90)	2,299 (10.67%)
3	Bipolar Disorder (296.80)	904 (6.16%)	Unspecified Disturbance of Conduct (312.9)	1,019 (5.73%)	Pick's Disease (311)	1,156 (5.37%)
4	Unspecified Disturbance of Conduct (312.9)	798 (5.43%)	Bipolar Disorder (296.80)	1,010 (5.68%)	Bipolar Disorder (296.80)	1,059 (4.92%)
5	Unspecified Psychosis (298.9)	767 (5.22%)	Pick's Disease (311)	857 (4.82%)	Unspecified Disturbance of Conduct (312.9)	1,059 (4.92%)
6	Pick's Disease (311)	743 (5.06%)	Unspecified Psychosis (298.9)	788 (4.43%)	Unspecified Psychosis (298.9)	945 (4.39%)
7	Other Pervasive Development Disorder (299.80)	626 (4.26%)	Other Pervasive Development Disorder (299.80)	734 (4.13%)	Other Pervasive Development Disorder (299.80)	765 (3.55%)
8	Impulse Control Disorder (312.30)	516 (3.51%)	Unspecified Special Symptom (307.9)	654 (3.68%)	Unspecified Special Symptom (307.9)	735 (3.41%)
9	Schizoaffective Disorder (295.70)	501 (3.41%)	Impulse Control Disorder (312.30)	597 (3.36%)	Anxiety State, Unspecified (300.00)	718 (3.33%)
10	Unspecified Special Symptom (307.9)	454 (3.09%)	Schizoaffective Disorder (295.70)	574 (3.23%)	Explosive Personality Disorder (301.3)	652 (3.03%)
Total		8110 / 55.21%		10,071 / 56.64%		12,511 / 58.09%

*ICD-9 Dictionary Source [83]

Table 24 Top 10 Primary Procedure Codes by Year across all Disability for Psychiatric Visits

Primary Procedure Preformed (CPT Code)						
Top 10	2009-2010		2011-2012		2013-2014	
1	Emergency Department Visit Level 4 (99284)	1,285 (21.60%)	Emergency Department Visit Level 3 (99283)	2,167 (23.74%)	Emergency Department Visit Level 3 (99283)	2,676 (23.16%)
2	Emergency Department Visit Level 5 (99285)	1,241 (20.86%)	Emergency Department Visit Level 4 (99284)	1,980 (21.69%)	Emergency Department Visit Level 5 (99285)	2,396 (20.74%)
3	Emergency Department Visit Level 3 (99283)	1,217 (20.46%)	Emergency Department Visit Level 5 (99285)	1,922 (21.06%)	Emergency Department Visit Level 4 (99284)	2,386 (20.65%)
4	Emergency Department Visit Level 2 (99282)	448 (7.53%)	Vascular Access Procedure (36415)	544 (5.96%)	Emergency Department Visit Level 2 (99282)	541 (4.68%)
5	Psychiatric Diagnostic Evaluation (90801)	361 (6.07%)	Emergency Department Visit Level 2 (99282)	446 (4.89%)	Vascular Access Procedure (36415)	470 (4.07%)
6	Vascular Access Procedure (36415)	301 (5.06%)	Psychiatric Diagnostic Evaluation (90801)	393 (4.31%)	Metabolic Panel (80053)	346 (2.99%)
7	Emergency Department Visit Level 1 (99281)	180 (3.03%)	Emergency Department Visit Level 1 (99281)	182 (1.99%)	Psychiatric Diagnostic Evaluation (90791)	291 (2.52%)
8	Drug Screen (80101)	178 (2.99%)	Drug Screen (80101)	144 (1.58%)	Emergency Department Visit Level 1 (99281)	220 (1.90%)
9	Computed tomography, head or brain (70450)	56 (0.94%)	Metabolic Panel (80053)	141 (1.54%)	Drug Screen (80101)	362 (3.13%)
10	Therapeutic, prophylactic, or diagnostic injection-subacute (96372)	52 (0.87%)	Therapeutic, prophylactic, or diagnostic injection-subacute (96372)	131 (1.44%)	Psychotherapy for Crisis (90839)	122 (1.06%)
Total		5,319 / 89.41%		8,050 / 88.2%		9,810 / 84.40%

*CPT Code Definition Source [72]

Table 25 Bivariate Results of Psychiatric Care Visits Analysis

Variable	Value	Count (%) of Psychiatric Visit	Count (%) of Medical Visit	P-Value
Weekend Admission	Admitted Monday-Friday	40,118 (78.4%)	169,676 (72.1%)	<.001
	Admitted Saturday-Sunday	11,025 (21.6%)	65,787 (28.0%)	
ED Trauma Level	Not Trauma Center	17,261 (33.7%)	82,946 (35.2%)	<.001
	Trauma Level 1	13,584 (26.6%)	64,824 (27.5%)	
	Trauma Level 2	6,917 (13.5%)	24,163 (10.3%)	
	Trauma Level 3	2,645 (5.2%)	14,264 (6.1%)	
	Unclassified	10,745 (21.0%)	49,309 (20.9%)	
Age	Preschool 3-5	796 (1.6%)	45,091 (19.2%)	<.001
	Elementary 6-11	7,765 (2.7%)	65,823 (28.0%)	
	Middle/High 12-18	21,245 (41.5%)	61,470 (26.1%)	
	Young Adult 19-25	21,346 (41.7%)	63,122 (26.8%)	
Sex	Female	15,037 (29.4%)	86,552 (36.8%)	<.001
	Male	36,113 (70.6%)	148,917 (63.2%)	
Payer Source #1	Medicare	3,449 (6.8%)	10,259 (4.4%)	<.001
	Medicaid	29,231 (57.2%)	142,940 (60.8%)	
	Private Insurance	14,671 (28.7%)	65,876 (28.0%)	
	Self-Pay	1,995 (3.9%)	6,492 (2.8%)	
	Other	1,726 (3.4%)	9,652 (4.1%)	
Payer Source #2	Medicare	798 (4.7%)	1,528 (2.7%)	<.001
	Medicaid	8,778 (51.2%)	28,883 (50.9%)	
	Private Insurance	3,582 (20.9%)	8,728 (15.4%)	
	Self-Pay	3,425 (20.0%)	15,166 (26.7%)	
	Other	578 (3.4%)	2,463 (4.3%)	
Zip Code Income Quarterlies	0 to 25th Percentile	13,694 (27.5%)	68,058 (29.44%)	<.001
	26th to 50th Percentile	12,583 (25.3%)	62,950 (27.2%)	
	51st to 75th Percentile	12,194 (24.5%)	55,443 (24.0%)	
	76th to 100th Percentile	11,333 (22.8%)	44,740 (19.4%)	
Patient Rurality	Central counties of metro area >=1 Million Population	16,125 (31.5%)	74,612 (26.0%)	<.001
	Fringe counties of metro area >=1 Million Population	12,579 (31.5%)	52,947 (22.5%)	
	Metro County 250,000 to 999,999 Population	11,592 (22.7%)	52,713 (22.4%)	
	Metro County of 50,000 to 249,999 Population	4,309 (8.4%)	20,645 (8.8%)	
	Micropolitan	4,243 (8.3%)	21,487 (9.1%)	
	Non-Metro/Micro County	2,024 (4.0%)	12,290 (5.2%)	
Disability	Autism	26,448 (51.8%)	79,816 (33.9%)	<.001
	Cerebral Palsy	1,909 (3.7%)	58,637 (24.9%)	
	Intellectual Disability	22,419 (43.8%)	79,920 (33.9%)	
	Spina Bifida	336 (0.7%)	17,133 (7.3%)	

Table 26 Correlation Among Disability for Psychiatric Visits

	Autism	Cerebral Palsy	Intellectual Disability	Spina Bifida
Autism	1.000	-0.230****	-0.759****	-0.0839****
Cerebral Palsy	-0.230****	1.000	-0.086****	0.068****
Intellectual Disability	-0.759****	-0.086****	1.000	-0.040****
Spina Bifida	-0.084****	0.068****	-0.040****	1.000

* p-value <.05
** p-value <.01
*** p-value <.001
**** p-vale <.0001

Table 27 Logistic Regression Results for Psychiatric Care Visits Individual Disabilities

Variable	Comparison	Odds Ratio	OR 95% CI
Admission on Weekend	Weekend	0.727****	0.709-0.746
ED Trauma Level	Not Trauma Center	Ref	
	Trauma Level 1	0.847****	0.820-0.876
	Trauma Level 2	0.756****	0.726-0.786
	Trauma Level 3	1.294****	1.227-1.364
	Unclassified	1.171****	1.135-1.207
Age	Young Adult 19-25	Ref	
	Preschool 3-5	24.913****	23.127-26.838
	Elementary 6-11	3.835****	3.713-3.961
	Middle/High 12-18	1.182****	1.152-1.213
Sex	Male	0.882****	0.861-0.903
Payer Source #1	Medicaid	Ref	
	Medicare	1.117****	1.064-1.173
	Private Insurance	1.129****	1.100-1.159
	Self-Pay	0.804****	0.758-0.852
	Other	1.117***	1.053-1.184
Payer Source #2	Government Insurance	Ref	
	Other/None	1.416****	1.373-1.460
Income in Zip Code	0 to 25th Percentile	Ref	
	26th to 50th Percentile	1.002	0.973-1.032
	51st to 75th Percentile	0.950**	0.922-0.980
	76th to 100th Percentile	0.932****	0.900-0.964
Patient Rurality	Central County (>= 1 Million Population)	Ref	
	Fringe County (>= 1 Million Population	0.948***	0.920-0.978
	Large Metro County (250,000 to 999,999 Population)	0.984	0.955-1.014
	Small Metro County (50,000 to 249,999 Population)	0.956*	0.916-0.998
	Micropolitan	1.014	0.972-1.059
	Non-Metro/Micro County	1.116***	1.054-1.181
Autism	Disability Present	2.149****	2.062-2.240
Cerebral Palsy	Disability Present	0.144****	0.137-0.151
Intellectual Disability	Disability Present	1.383****	1.329-1.439
Spina Bifida	Disability Present	0.109****	0.097-0.123
Year	2009	Ref	
	2010	0.977	0.938-1.018
	2011	1.101****	1.057-1.147
	2012	1.053***	1.013-1.095
	2013	1.135****	1.091-1.180
	2014	0.930***	0.896-0.965

* p-value <.05
** p-value <.01
*** p-value <.001
**** p-vale <.0001

Table 28 Logistic Regression Results for Psychiatric Care Visits Disability Total

Variable	Comparison	Odds Ratio	OR 95% CI
Admission on Weekend	Weekend	0.739****	0.721-0.757
ED Trauma Level	Not Trauma Center	Ref	
	Trauma Level 1	0.960*	0.931-0.990
	Trauma Level 2	0.764****	0.736-0.793
	Trauma Level 3	1.209****	1.149-1.271
	Unclassified	1.108****	1.076-1.141
Age	Young Adult 19-25	Ref	
	Preschool 3-5	20.006****	18.589-21.532
	Elementary 6-11	2.995****	2.907-3.086
	Middle/High 12-18	1.003	0.980-1.027
Sex	Male	0.652****	0.638-.667
Payer Source #1	Medicaid	Ref	
	Medicare	1.102****	1.052-1.153
	Private Insurance	1.070****	1.044-1.097
	Self-Pay	0.776****	0.734-0.820
	Other	1.127****	1.066-1.192
Payer Source #2	Government Insurance	Ref	
	Other/None	1.418****	1.378-1.460
Income in Zip Code	0 to 25th Percentile	Ref	
	26th to 50th Percentile	1.013	0.985-1.042
	51st to 75th Percentile	0.942****	0.915-0.970
	76th to 100th Percentile	0.868****	0.840-0.896
Patient Rurality	Central County (>= 1 Million Population)	Ref	
	Fringe County (>= 1 Million Population	0.954*	0.928-0.982
	Large Metro County (250,000 to 999,999 Population)	1.004	0.975-1.032
	Small Metro County (50,000 to 249,999 Population)	1.017	0.976-1.059
	Micropolitan	1.041	1.000-1.084
	Non-Metro/Micro County	1.273****	1.206-1.343
Number of I/DD Disabilities	1 Disability	Ref	
	2 Disability	1.409****	1.362-1.459
	3 or 4 Disability	3.414****	2.868-4.064
Year	2009	Ref	
	2010	0.951*	0.915-0.989
	2011	0.999	0.962-1.038
	2012	0.936***	0.902-0.971
	2013	0.973	0.937-1.009
	2014	0.775****	0.748-0.802

* p-value <.05
** p-value <.01
*** p-value <.001
**** p-vale <.0001

Table 29 Collinearity Analysis of Psychiatric Care Visits-Conceptual Framework Variables

Variable Interaction	Chi-Square	Lambda Symmetric	Uncertainty Coefficient Symmetric
Admission on Weekend x Sex	0.0893	0.0000	0.0000
Admission on Weekend x Payer Source #1	16.7946**	0.0000	0.0000
Admission on Weekend x Payer Source #2	0.8322	0.0000	0.0000
Admission on Weekend x Income in Zip Code	2.0044	0.0000	0.0000
Admission on Weekend x ED Trauma Level	142.3741****	0.0000	0.0002
Admission on Weekend x Patient Rurality	53.3012****	0.0000	0.0001
Admission on Weekend x Age	479.1184****	0.0000	0.0009
Sex x Payer Source #1	378.2365****	0.0000	0.0008
Sex x Payer Source #2	38.0367****	0.0000	0.0001
Sex x Income in Zip Code	74.4828****	0.0000	0.0001
Sex x ED Trauma Level	91.3895****	0.0000	0.0002
Sex x Patient Rurality	133.5108****	0.0000	0.0002
Sex x Age	2,012.3363****	0.0172	0.0035
Payer Source #1 x Payer Source #2	32,1103420****	0.0492	0.0646
Payer Source #1 x Income in Zip Code	23,078.1424****	0.0728	0.0335
Payer Source #1 x ED Trauma Level	1,356.3151****	0.0000	0.0019
Payer Source #1 x Patient Rurality	5,187.0977****	0.0051	0.0064
Payer Source #1 x Age	31,884.4560****	0.0390	0.0442
Payer Source #2 x Income in Zip Code	221.9929****	0.0000	0.0004
Payer Source #2 x ED Trauma Level	526.9392****	0.0000	0.0010
Payer Source #2 x Patient Rurality	2,207.1765****	0.0040	0.0038
Payer Source #2 x Age	4,739.2823****	0.0222	0.0090
Income in Zip Code x ED Trauma Level	2,679.2228****	0.0096	0.0034
Income in Zip Code x Patient Rurality	53,209.6560****	0.0871	0.0671
Income in Zip Code x Age	608.8516****	0.0059	0.0008
ED Trauma Level x Patient Rurality	33,943.2182****	0.0405	0.0361
ED Trauma Level x Age	3869.4136****	0.0187	0.0049
Patient Rurality x Age	334.2927****	0.0030	0.0004

* p-value <.05
** p-value <.01
*** p-value <.001
**** p-vale <.0001

Table 30 Collinearity Analysis of Psychiatric Care Visits-Disability Variables

Variable Interaction	Chi-Square	Lambda Symmetric	Uncertainty Coefficient Symmetric
ASD x Admission on Weekend	0.7970	0.0000	0.0000
ASD x Sex	19,992.4724****	0.0160	0.0546
ASD x Payer Source #1	4,399.5710****	0.0000	0.0092
ASD x Payer Source #2	397.4190****	0.0000	0.0013
ASD x Income in Zip Code	1,563.2487****	0.0000	0.0027
ASD x ED Trauma Level	1,461.6633****	0.0000	0.0024
ASD x Patient Rurality	954.4104****	0.0000	0.0014
Cerebral Palsy x Admission on Weekend	0.0542	0.0000	0.0000
Cerebral Palsy x Sex	3,790.1143****	0.0000	0.0105
Cerebral Palsy x Payer Source #1	978.0465****	0.0000	0.0021
Cerebral Palsy x Payer Source #2	3.1089	0.0000	0.0000
Cerebral Palsy x Income in Zip Code	418.9682****	0.0000	0.0008
Cerebral Palsy x ED Trauma Level	1,003.5359****	0.0000	0.0017
Cerebral Palsy x Patient Rurality	343.6134****	0.0000	0.0005
Intellectual Disability x Admission on Weekend	4.80669	0.0000	0.0000
Intellectual Disability x Sex	4,558.6370****	0.0000	0.0121
Intellectual Disability x Payer Source #1	4,490.3748****	0.0069	0.0092
Intellectual Disability x Payer Source #2	999.8450****	0.0000	0.0032
Intellectual Disability x Income in Zip Code	268.2801****	0.0000	0.0005
Intellectual Disability x ED Trauma Level	545.7245****	0.0000	0.0009
Intellectual Disability x Patient Rurality	1,297.4820****	0.0000	0.0020
Spina Bifida x Admission on Weekend	3.5580	0.0000	0.0000
Spina Bifida x Sex	2,080.1387****	0.0042	0.0079
Spina Bifida x Payer Source #1	113.1386****	0.0000	0.0003
Spina Bifida x Payer Source #2	72.950****	0.0000	0.0004
Spina Bifida x Income in Zip Code	54.0073****	0.0000	0.0001
Spina Bifida x ED Trauma Level	1,430.5623****	0.0107	0.0028
Spina Bifida x Patient Rurality	79.0043****	0.0000	0.0001

* p-value <.05
** p-value <.01
*** p-value <.001
**** p-vale <.0001

Table 31 Top 10 Primary Diagnosis for Each Disability Across All Six Years for Injury Visits

Primary Visit Diagnosis (ICD-9)								
Top 10	Autism Spectrum Disorder		Cerebral Palsy		Intellectual Disabilities		Spina Bifida & Other Congenital Anomalies	
1	Head Injury, Unspecified (959.01)	2,010 (5.90%)	Head Injury, Unspecified (959.01)	3,608 (5.82%)	Head Injury, Unspecified (959.01)	897 (4.93%)	Head Injury, Unspecified (959.01)	125 (5.80%)
2	Contusion of Face, Scalp, and Neck (920)	1,754 (5.15%)	Contusion of Face, Scalp, and Neck (920)	3,034 (4.89%)	Contusion of Face, Scalp, and Neck (920)	787 (4.33%)	Contusion of Face, Scalp, and Neck (920)	106 (4.92%)
3	Open Wound of Scalp (873.0)	1,240 (3.64%)	Open Wound of Scalp (873.0)	1,957 (3.15%)	Open Wound of Forehead (873.42)	488 (2.68%)	Sprain of Neck (847.0)	60 (2.78%)
4	Open Wound of Forehead (873.42)	1,189 (3.49%)	Open Wound of Forehead (873.42)	1,940 (3.13%)	Open Wound of Scalp (873.0)	480 (2.64%)	Sprain of Ankle (845.00)	45 (2.09%)
5	Sprain of Ankle (845.00)	831 (2.44%)	Sprain of Ankle (845.00)	1,554 (2.50%)	Sprain of Ankle (845.00)	432 (2.38%)	Sprain of Lumbar (847.2)	42 (1.95%)
6	Open Wound of Finger (883.0)	710 (2.09%)	Open Wound of Finger (883.0)	1,115 (1.80%)	Abrasion of Face, Neck, and Scalp (910.0)	307 (1.69%)	Closed Fracture of Femur (821.01)	40 (1.86%)
7	Abrasion of Face, Neck, and Scalp (910.0)	543 (1.59%)	Abrasion of Face, Neck, and Scalp (910.0)	966 (1.56%)	Open Wound of Finger (883.0)	275 (1.51%)	Open Wound of Forehead (873.42)	40 (1.86%)
8	Open Wound of Lip (873.43)	524 (1.54%)	Open Wound of Lip (873.43)	874 (1.41%)	Epilepsy, Unspecified (345.90)	247 (1.36%)	Concussion (850.0)	34 (1.58%)
9	Foreign Body in Ear (931)	503 (1.48%)	Open Wound of Jaw (873.44)	778 (1.25%)	Open Wound of Lip (873.43)	232 (1.28%)	Closed Fracture of Lower end of Femur (821.20)	31 (1.44%)
10	Open Wound of Jaw (873.44)	433 (1.27%)	Sprain of Neck (847.0)	689 (1.11%)	Foreign Body in Digestive System (938)	222 (1.22%)	Knee, Leg, Ankle and Foot Injury (959.7)	30 (1.39%)
Total		9737 / 28.59%		16515 / 26.62%		4367 / 24.02%		553 / 25.67%

*ICD-9 Dictionary Source [83]

Table 32 Top 10 Primary Procedures for Each Disability Diagnosis Across All Six Years for Injury Visits

Primary Procedure Preformed (CPT Code)								
Top 10	Autism Spectrum Disorder		Cerebral Palsy		Intellectual Disabilities		Spina Bifida & Other Congenital Anomalies	
1	Emergency Department Visit Level 3 (99283)	7,204 (31.53%)	Emergency Department Visit Level 3 (99283)	12,013 (30.51%)	Emergency Department Visit Level 3 (99283)	3,149 (29.77%)	Emergency Department Visit Level 3 (99283)	302 (27.31%)
2	Emergency Department Visit Level 2 (99282)	3,508 (15.35%)	Emergency Department Visit Level 2 (99282)	5,596 (14.21%)	Emergency Department Visit Level 2 (99282)	1,371 (12.96%)	Emergency Department Visit Level 2 (99282)	120 (10.85%)
3	Emergency Department Visit Level 4 (99284)	2,232 (9.77%)	Emergency Department Visit Level 4 (99284)	3,972 (10.09%)	Emergency Department Visit Level 4 (99284)	1,140 (10.78%)	Emergency Department Visit Level 4 (99284)	119 (10.76%)
4	Emergency Department Visit Level 1 (99281)	1,003 (4.39%)	Computed tomography, head or brain (70450)	1,775 (4.51%)	Emergency Department Visit Level 5 (99285)	525 (4.96%)	Computed tomography, head or brain (70450)	86 (7.78%)
5	Computed tomography, head or brain (70450)	878 (3.84%)	Emergency Department Visit Level 1 (99281)	1,568 (3.98%)	Computed tomography, head or brain (70450)	510 (4.82%)	Emergency Department Visit Level 1 (99281)	35 (3.16%)
6	Emergency Department Visit Level 5 (99285)	869 (3.80%)	Emergency Department Visit Level 5 (99285)	1,545 (3.92%)	Emergency Department Visit Level 1 (99281)	352 (3.33%)	Emergency Department Visit Level 5 (99285)	26 (2.35%)
7	Simple Repair of body superficial wound 2.5 cm or less (12001)	575 (2.52%)	Simple Repair of face superficial wound 2.5 cm or less (12011)	934 (2.37%)	Simple Repair of face superficial wound 2.5 cm or less (12011)	245 (2.32%)	Complete Radiologic Exam of Foot (73630)	23 (2.08%)
8	Simple Repair of face superficial wound 2.5 cm or less (12011)	549 (2.40%)	Simple Repair of body superficial wound 2.5 cm or less (12001)	878 (2.23%)	Simple Repair of body superficial wound 2.5 cm or less (12001)	179 (1.69%)	Simple Repair of body superficial wound 2.5 cm or less (12001)	21 (1.90%)
9	Vascular Access Procedure (36415)	267 (1.17%)	Vascular Access Procedure (36415)	521 (1.32%)	Vascular Access Procedure (36415)	170 (1.61%)	Vascular Access Procedure (36415)	17 (1.54%)
10	Simple Repair of body superficial wound 2.6 to 7.5 cm (12002)	245 (1.07%)	Simple Repair of body superficial wound 2.6 to 7.5 cm (12002)	382 (0.97%)	Complete Radiologic Exam of Ankle (73610)	100 (0.95%)	Simple Repair of face superficial wound 2.5 cm or less (12011)	16 (1.45%)
Total		17330/ 75.84%		29184/ 74.11%		7741/ 73.19%		765/ 69.18%

*CPT Code Definition Source [72]

Table 33 Top 10 Primary Diagnosis Codes by Year across All Disability for Injury Visits

Primary Visit Diagnosis (ICD-9)						
Top 10	2009-2010		2011-2012		2013-2014	
1	Contusion of Face, Scalp, and Neck (920)	987 (5.61%)	Head Injury, Unspecified (959.01)	1,258 (6.00%)	Head Injury, Unspecified (959.01)	1,390 (5.92%)
2	Head Injury, Unspecified (959.01)	960 (5.46%)	Contusion of Face, Scalp, and Neck (920)	1,011 (4.82%)	Contusion of Face, Scalp, and Neck (920)	1,036 (4.41%)
3	Open Wound of Scalp (873.0)	651 (3.70%)	Open Wound of Forehead (873.42)	655 (3.12%)	Open Wound of Forehead (873.42)	698 (2.97%)
4	Open Wound of Forehead (873.42)	587 (3.34%)	Open Wound of Scalp (873.0)	635 (3.03%)	Open Wound of Scalp (873.0)	671 (2.86%)
5	Sprain of Ankle (845.00)	371 (2.11%)	Sprain of Ankle (845.00)	528 (2.52%)	Sprain of Ankle (845.00)	655 (2.79%)
6	Open Wound of Finger (883.0)	332 (1.89%)	Open Wound of Finger (883.0)	396 (1.89%)	Open Wound of Finger (883.0)	387 (1.65%)
7	Open Wound of Jaw (873.44)	258 (1.47%)	Abrasion of Face, Neck, and Scalp (910.0)	328 (1.56%)	Abrasion of Face, Neck, and Scalp (910.0)	382 (1.63%)
8	Abrasion of Face, Neck, and Scalp (910.0)	256 (1.46%)	Open Wound of Lip (873.43	298 (1.42%)	Open Wound of Lip (873.43	322 (1.37%)
9	Open Wound of Lip (873.43	254 (1.44%)	Open Wound of Jaw (873.44)	263 (1.25%)	Sprain of Neck (847.0)	271 (1.15%)
10	Epilepsy, Unspecified (345.90)	222 (1.26%)	Sprain of Neck (847.0)	223 (1.06%)	Knee, Leg, Ankle and Foot Injury (959.7)	259 (1.10%)
Total		4878/ 27.74%		5595/ 26.67%		6,071/ 25.85%

*ICD-9 Dictionary Source [82]

Table 34 Top 10 Procedure Codes by Year across all Disability for Injury Visits

Primary Procedure Preformed (CPT Code)						
Top 10	2009-2010		2011-2012		2013-2014	
1	Emergency Department Visit Level 3 (99283)	2,929 (29.54%)	Emergency Department Visit Level 3 (99283)	4,157 (30.72%)	Emergency Department Visit Level 3 (99283)	4,927 (30.93%)
2	Emergency Department Visit Level 2 (99282)	1,517 (15.30%)	Emergency Department Visit Level 2 (99282)	1,931 (14.27%)	Emergency Department Visit Level 2 (99282)	2,148 (13.48%)
3	Emergency Department Visit Level 4 (99284)	927 (9.35%)	Emergency Department Visit Level 4 (99284)	1,338 (9.89%)	Emergency Department Visit Level 4 (99284)	1,707 (10.72%)
4	Computed tomography, head or brain (70450)	531 (5.36%)	Computed tomography, head or brain (70450)	633 (4.68%)	Emergency Department Visit Level 1 (99281	697 (4.38%)
5	Emergency Department Visit Level 1 (99281	421 (4.25%)	Emergency Department Visit Level 5 (99285)	548 (4.05%)	Emergency Department Visit Level 5 (99285)	668 (4.19%)
6	Emergency Department Visit Level 5 (99285)	329 (3.32%)	Emergency Department Visit Level 1 (99281	450 (3.33%)	Computed tomography, head or brain (70450)	611 (3.84%)
7	Simple Repair of face superficial wound 2.5 cm or less (12011)	291 (2.93%)	Simple Repair of face superficial wound 2.5 cm or less (12011)	346 (2.56%)	Simple Repair of body superficial wound 2.5 cm or less (12001)	309 (1.94%)
8	Simple Repair of body superficial wound 2.5 cm or less (12001)	263 (2.65%)	Simple Repair of body superficial wound 2.5 cm or less (12001)	306 (2.26%)	Simple Repair of face superficial wound 2.5 cm or less (12011)	297 (1.86%)
9	Simple Repair of body superficial wound 2.6 to 7.5 cm (12002)	125 (1.26%)	Vascular Access Procedure (36415)	205 (1.52%)	Vascular Access Procedure (36415)	205 (1.29%)
10	Vascular Access Procedure (36415)	111 (1.12%)	Complete Radiologic Exam of Ankle (73610)	135 (1.00%)	Complete Radiologic Exam of Foot (73630)	148 (0.93%)
Total		7444/ 75.08%		10049/ 74.28%		11717/ 73.65%

*CPT Code Definition Source [72]

Table 35 Bivariate Results for Injury Care Visits Analysis

Variable	Value	Count (%) of Injury Visit	Count (%) of Medical Visit	P-Value
Weekend Admission	Admitted Monday-Friday	42,774 (72.3%)	169,676 (72.1%)	0.26
	Admitted Saturday-Sunday	16,382 (27.7%)	65,787 (28.0%)	
ED Trauma Level	Not Trauma Center	24,184 (40.9%)	82,946 (35.2%)	<.001
	Trauma Level 1	11,884 (20.1%)	64,824 (27.5%)	
	Trauma Level 2	6,361 (10.8%)	24,163 (10.3%)	
	Trauma Level 3	4,062 (6.9%)	14,264 (6.1%)	
	Unclassified	12,644 (21.4%)	49,309 (20.9%)	
Age	Preschool 3-5	9,726 (16.5%)	45,091 (19.2%)	<.001
	Elementary 6-11	17,151 (29.0%)	65,823 (28.0%)	
	Middle/High 12-18	17,082 (25.7%)	61,470 (26.1%)	
	Young Adult 19-25	15,176 (26.7%)	63,122 (26.8%)	
Sex	Female	17,081 (28.9%)	86,552 (36.8%)	<.001
	Male	42,042 (71.1%)	148,917 (63.2%)	
Payer Source #1	Medicare	2,276 (3.9%)	10,259 (4.4%)	<.001
	Medicaid	32,486 (55.0%)	142,940 (60.8%)	
	Private Insurance	19,699 (33.4%)	65,876 (28.0%)	
	Self-Pay	2,032 (3.4%)	6,492 (2.8%)	
	Other	2,563 (4.3%)	9,652 (4.1%)	
Payer Source #2	Medicare	428 (2.8%)	1,528 (2.7%)	<.001
	Medicaid	7,313 (47.4%)	28,883 (50.9%)	
	Private Insurance	3,137 (20.3%)	8,728 (15.4%)	
	Self-Pay	3,843 (24.9%)	15,166 (26.7%)	
	Other	711 (4.6%)	2,463 (4.3%)	
Zip Code Income Quarterlies	0 to 25th Percentile	15,570 (26.8%)	68,058 (29.44%)	<.001
	26th to 50th Percentile	15,467 (26.6%)	62,950 (27.2%)	
	51st to 75th Percentile	14,023 (24.1%)	55,443 (24.0%)	
	76th to 100th Percentile	13,111 (22.5%)	44,740 (19.4%)	
Patient Rurality	Central counties of metro area >=1 Million Population	16,331 (27.6%)	74,612 (26.0%)	<.001
	Fringe counties of metro area >=1 Million Population	14,319 (24.2%)	52,947 (22.5%)	
	Metro County 250,000 to 999,999 Population	13,970 (23.6%)	52,713 (22.4%)	
	Metro County of 50,000 to 249,999 Population	5,475 (9.3%)	20,645 (8.8%)	
	Micropolitan	5,859 (9.9%)	21,487 (9.1%)	
	Non-Metro/Micro County	2,980 (5.0%)	12,290 (5.2%)	
Disability	Autism	30,111 (50.9%)	79,816 (33.9%)	<.001
	Cerebral Palsy	10,307 (17.4%)	58,637 (24.9%)	
	Intellectual Disability	16,585 (28.1%)	79,920 (33.9%)	
	Spina Bifida	2,132 (3.6%)	17,133 (7.3%)	

Table 36 Correlation Among Disability for Injury Care Visits

	Autism	Cerebral Palsy	Intellectual Disability	Spina Bifida
Autism	1.000	-0.498****	-0.558****	-0.200****
Cerebral Palsy	-0.498****	1.000	-0.161****	-0.048****
Intellectual Disability	-0.558****	-0.161****	1.000	-0.091****
Spina Bifida	-0.200****	-0.048****	-0.091****	1.000

* p-value <.05
** p-value <.01
*** p-value <.001
**** p-vale <.0001

Table 37 Logistic Regression Results for Injury Care Visits Individual Disability

Variable	Comparison	Odds Ratio	OR 95% CI
Admission on Weekend	Weekend	0.970***	0.950-0.990
ED Trauma Level	Not Trauma Center	Ref	
	Trauma Level 1	1.269****	1.232-1.308
	Trauma Level 2	1.006	0.971-1.042
	Trauma Level 3	0.975	0.934-1.014
	Unclassified	0.906****	0.883-0.930
Age	Young Adult 19-25	Ref	
	Preschool 3-5	1.302****	1.263-1.343
	Elementary 6-11	1.112****	1.082-1.142
	Middle/High 12-18	0.983	0.957-1.010
Sex	Male	0.843****	0.825-0.860
Payer Source #1	Medicaid	Ref	
	Medicare	1.017	0.966-1.071
	Private Insurance	0.838****	0.820-0.857
	Self-Pay	0.786****	0.746-0.829
	Other	0.881****	0.841-0.922
Payer Source #2	Government Insurance	Ref	
	Other/None	1.002	0.973-1.032
Income in Zip Code	0 to 25th Percentile	Ref	
	26th to 50th Percentile	0.981	0.957-1.007
	51st to 75th Percentile	0.952***	0.926-0.978
	76th to 100th Percentile	0.877****	0.851-0.904
Patient Rurality	Central County (>= 1 Million Population)	Ref	
	Fringe County (>= 1 Million Population	0.930****	0.905-0.955
	Large Metro County (250,000 to 999,999 Population)	0.857****	0.835-0.880
	Small Metro County (50,000 to 249,999 Population)	0.862****	0.831-0.895
	Micropolitan	0.848****	0.818-0.879
	Non-Metro/Micro County	0.916***	0.874-0.959
Autism	Disability Present	1.259****	1.212-1.308
Cerebral Palsy	Disability Present	0.587****	0.566-0.609
Intellectual Disability	Disability Present	0.765****	0.739-0.792
Spina Bifida	Disability Present	0.490****	0.463-0.518
Year	2009	Ref	
	2010	0.936***	0.904-0.969
	2011	0.930****	0.898-0.963
	2012	0.937***	0.906-0.969
	2013	0.952**	0.921-0.984
	2014	0.945***	0.915-0.977

* p-value <.05
** p-value <.01
*** p-value <.001
**** p-vale <.0001

Table 38 Logistic Regression Results for Injury Care Visits Disability Total

Variable	Comparison	Odds Ratio	OR 95% CI
Admission on Weekend	Weekend	0.976*	0.956-0.996
ED Trauma Level	Not Trauma Center	Ref	
	Trauma Level 1	1.361****	1.322-1.401
	Trauma Level 2	1.018	0.983-1.055
	Trauma Level 3	0.946**	0.907-0.986
	Unclassified	0.881****	0.859-0.904
Age	Young Adult 19-25	Ref	
	Preschool 3-5	1.136****	1.103-1.171
	Elementary 6-11	0.947****	0.923-0.972
	Middle/High 12-18	0.884****	0.861-0.908
Sex	Male	0.712****	0.698-0.726
Payer Source #1	Medicaid	Ref	
	Medicare	1.012	0.961-1.066
	Private Insurance	0.810****	0.792-0.827
	Self-Pay	0.765****	0.726-0.806
	Other	0.873****	0.834-0.914
Payer Source #2	Government Insurance	Ref	
	Other/None	0.984	0.956-1.014
Income in Zip Code	0 to 25th Percentile	Ref	
	26th to 50th Percentile	0.978	0.954-1.003
	51st to 75th Percentile	0.946****	0.921-0.972
	76th to 100th Percentile	0.850****	0.825-0.876
Patient Rurality	Central County (>= 1 Million Population)	Ref	
	Fringe County (>= 1 Million Population	0.922****	0.898-0.947
	Large Metro County (250,000 to 999,999 Population)	0.852****	0.830-0.875
	Small Metro County (50,000 to 249,999 Population)	0.875****	0.843-0.907
	Micropolitan	0.855****	0.826-0.886
	Non-Metro/Micro County	0.964	0.921-1.009
Number of I/DD Disabilities	1 Disability	Ref	
	2 Disability	1.543****	1.489-1.600
	3 or 4 Disability	1.743****	1.524-1.992
Year	2009	Ref	
	2010	0.923****	0.892-0.955
	2011	0.879****	0.850-0.910
	2012	0.878****	0.850-0.908
	2013	0.876****	0.848-0.906
	2014	0.857****	0.830-0.885

* p-value <.05
** p-value <.01
*** p-value <.001
**** p-vale <.0001

Table 39 Collinearity Analysis of Injury Care Visits-Conceptual Framework Variables

Variable Interaction	Chi-Square	Lambda Symmetric	Uncertainty Coefficient Symmetric
Admission on Weekend x Sex	3.4480	0.0000	0.0000
Admission on Weekend x Payer Source #1	33.5303****	0.0000	0.0001
Admission on Weekend x Payer Source #2	0.3910	0.0000	0.0000
Admission on Weekend x Income in Zip Code	10.7830*	0.0000	0.0000
Admission on Weekend x ED Trauma Level	123.8877****	0.0000	0.0002
Admission on Weekend x Patient Rurality	62.9799****	0.0000	0.0001
Admission on Weekend x Age	344.3072****	0.0000	0.0006
Sex x Payer Source #1	384.8006****	0.0000	0.0008
Sex x Payer Source #2	37.5316****	0.0000	0.0001
Sex x Income in Zip Code	63.9128****	0.0000	0.0001
Sex x ED Trauma Level	166.9801****	0.0000	0.0003
Sex x Patient Rurality	90.1668****	0.0000	0.0001
Sex x Age	2,209.4570****	0.0213	0.0037
Payer Source #1 x Payer Source #2	32,225.0096****	0.0590	0.0653
Payer Source #1 x Income in Zip Code	24,489.4417****	0.0789	0.0346
Payer Source #1 x ED Trauma Level	1,456.7980****	0.0000	0.0020
Payer Source #1 x Patient Rurality	5,379.9106****	0.0069	0.0065
Payer Source #1 x Age	32,215.0456****	0.0416	0.0409
Payer Source #2 x Income in Zip Code	305.2695****	0.0000	0.0006
Payer Source #2 x ED Trauma Level	686.5624****	0.0000	0.0013
Payer Source #2 x Patient Rurality	3,381.6752****	0.0108	0.0059
Payer Source #2 x Age	4,352.5860****	0.0275	0.0079
Income in Zip Code x ED Trauma Level	2,776.7210****	0.0099	0.0034
Income in Zip Code x Patient Rurality	55,741.0134****	0.0877	0.0680
Income in Zip Code x Age	333.4664****	0.0023	0.0004
ED Trauma Level x Patient Rurality	33,788.6721****	0.0295	0.0352
ED Trauma Level x Age	3,980.5121****	0.0147	0.0049
Patient Rurality x Age	397.7862****	0.0010	0.0004

* p-value <.05
** p-value <.01
*** p-value <.001
**** p-vale <.0001

Table 40 Collinearity Analysis of Injury Care Visits-Disability Variables

Variable Interaction	Chi-Square	Lambda Symmetric	Uncertainty Coefficient Symmetric
ASD x Admission on Weekend	53.0961****	0.0000	0.0001
ASD x Sex	19,900.3445****	0.0034	0.0531
ASD x Payer Source #1	3,453.5133****	0.0000	0.0071
ASD x Payer Source #2	458.8895****	0.0000	0.0015
ASD x Income in Zip Code	975.6222****	0.0000	0.0016
ASD x ED Trauma Level	2,337.9610****	0.0000	0.0038
ASD x Patient Rurality	660.3055****	0.0000	0.0010
Cerebral Palsy x Admission on Weekend	81.7171****	0.0000	0.0002
Cerebral Palsy x Sex	4,298.3796****	0.0000	0.0114
Cerebral Palsy x Payer Source #1	1,228.4567****	0.0000	0.0026
Cerebral Palsy x Payer Source #2	104.6170****	0.0000	0.0004
Cerebral Palsy x Income in Zip Code	445.5738****	0.0000	0.0008
Cerebral Palsy x ED Trauma Level	1,502.8427****	0.0000	0.0024
Cerebral Palsy x Patient Rurality	292.6845****	0.0000	0.0004
Intellectual Disability x Admission on Weekend	4.1087*	0.0000	0.0000
Intellectual Disability x Sex	4,160.7027****	0.0000	0.0108
Intellectual Disability x Payer Source #1	3,053.6707****	0.0009	0.0061
Intellectual Disability x Payer Source #2	662.3611****	0.0000	0.0022
Intellectual Disability x Income in Zip Code	36.3849****	0.0000	0.0001
Intellectual Disability x ED Trauma Level	657.3959****	0.0000	0.0011
Intellectual Disability x Patient Rurality	1,077.7020****	0.0000	0.0016
Spina Bifida x Admission on Weekend	22.0303****	0.0000	0.0001
Spina Bifida x Sex	2,316.5117****	0.0037	0.0084
Spina Bifida x Payer Source #1	100.3248****	0.0000	0.0003
Spina Bifida x Payer Source #2	36.3342****	0.0000	0.0002
Spina Bifida x Income in Zip Code	64.9866****	0.0000	0.0001
Spina Bifida x ED Trauma Level	1,666.1229****	0.0097	0.0031
Spina Bifida x Patient Rurality	81.5803****	0.0000	0.0001

* p-value <.05
** p-value <.01
*** p-value <.001
**** p-vale <.0001

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CURRICULM VITAE

Cody J. Mullen

Education

Richard M. Fairbanks School of Public Health — April 2019
Indiana University, IUPUI
Doctor of Philosophy, Health Policy and Management
Minor: Epidemiology

Purdue University, West Lafayette, IN — May 2012
Bachelor of Science, Interdisciplinary Science emphasis Statistics & Healthcare
Minors: Entrepreneurship, History, and Sociology

Honors, Awards, Fellowships

Hulman Early Careerist Award — 2018
Delta Omega Induction-IUPUI Chapter — 2018
American Public Health Association Medical Care Section Chair Citation — 2017
National Rural Health Association Fellow — 2014
Indiana University Graduate School Fellow — 2012-2013
Lilly Endowment Recipient — 2007

Professional Experience

Academic

Adjunct Faculty, Department of Health Policy and Management — Spring 2018-Present
Indiana University Purdue University, Indianapolis, IN

Adjunct Faculty, Department of Academic Skills and Advancement — Fall 2012-Present
Ivy Tech Community College-Lafayette

Associate Instructor, Department of Health Policy and Mgmt. — Summer 2013-Spring 2017
Indiana University Purdue University, Indianapolis, IN

Adjunct Faculty, Department of Health Care Support — Spring 2014
Ivy Tech Community College-Lafayette

Non-Academic

Policy, Research, and Development Officer — April 2017-Present
Indiana Rural Health Association & WhiteBark Corporation

Network Development Coordinator — May 2014-April 2017
Indiana Rural Health Association

Population Health Student Intern — September 2013-December 2013
Eskenazi Health System

Post-Graduate Research Associate May 2012-August 2012
Purdue University, West Lafayette

Conference Presentations-Selection

Mullen, C. J., "The Efforts of Tele-Behavioral Health in the Hospital: A Caregiver Perspective," Presentation at National Quality Forum Tele-Behavioral Health Meeting, Washington D.C., November 2018.

Mullen, C. J., "Introduction to PCORI, PCOR, and CER," Presentation at the Indiana School of Medicine PCORI Convening Meeting, Indianapolis, IN, September 2018.

Mullen, C. J., "An Overview of NIH All of Us Initiative," Presentation at the Oklahoma Rural Health Association Annual Meeting, Oklahoma City, OK, May 2018.

Mullen, C. J., "The Collaborative Care Model: The Next Challenge," Presentation at the National Rural Health Association Annual Meeting, New Orleans, LA, May 2018.

Mullen, C. J., Kelso, D., Anwar, A., Ellis, P., Ready, H., "A Population Health Perspective for Rural America," Presentation at Institute for Healthcare Improvement 29th Annual National Forum, Orlando, FL, December 2017.

Mullen, C. J., "MACRQ, QPP, CCM: What is the End Game?" Presentation at Alliant Management Semi-Annual CEO Meeting, Louisville, KY, August 2018.

Mullen, C. J., Maxey, H., Randolph, C., "Health Coaching to Manage Chronic Conditions Among Rural Patients: Results from a 3-Year Evaluation," Presentation at Indiana Rural Health Association Annual Meeting, French Lick, IN, June 2017.

Mullen, C. J., "MACRA. QPP, CCM: What is the End Game?," Presentation at National Rural Health Association Annual Meeting, San Diego, CA, May 2017.

Hayword, M., Srisaneha, E., Andrews, D., Mullen, C. J., "Are We Improving the Patient Experience?" Presentation at Institute for Healthcare Improvement 28th Annual National Forum, Orlando, FL, December 2016.

Bartel, R., Barrett, K., Bartel, D., Hoy, S., Mullen, C. J., "Caregiver 2.0: You Heard the Stories, Now What?" Presentation at Institute for Healthcare Improvement 28th Annual National Forum, Orlando, FL, December 2016.

Mullen, C. J., "Health Coaching and Chronic Care Management: A Possible Solution," Presentation at Kentucky Primary Care Association Annual Meeting, Lexington, KY, November 2016.

Mullen, C. J., "MACRA 101," Presentation at Indiana Rural Health Association Fall Forum, Indianapolis, IN, November 2016.

Mullen, C. J., "Population Health & Triple Aim Impact on Healthcare," Presentation at 2016 Indiana Healthcare Financial Management Association Fall Institute, Bloomington, IN, October 2016.

Mullen, C. J., "Health Coaching and Chronic Care Management: A Possible Solution," Presentation at South Central Telehealth Forum, Nashville, TN, August 2016.

Mullen, C. J., Chelminiak, K. "Evolution of Chronic Disease Management," Presentation at National Rural Health Association Rural Quality and Clinical Conference, Oakland, CA, July 2016.

Southard, E., Eberhard, R., Mullen, C. J., Owegi, R., "Community Paramedicine: What Can EMS Do for You?." Presentation at Indiana Rural Health Association Annual Meeting, French Lick, IN, June 2016.

Mullen, C. J., Rye, K., "The Importance of Local Care Coordination and Impact on Patient Outcomes," Presentation at Indiana Rural Health Association Annual Meeting, French Lick, IN, June 2016.

Southard, E., Eberhard, R., Mullen, C. J., Owegi, R., "Community Paramedicine: What Can EMS Do for You?." Presentation at National Rural Health Association Annual Meeting, Minneapolis, MN, May 2016.

Mullen, C. J., "Chronic Care Management: A Possible Solution," Presentation at National Rural Health Association Annual Meeting, Minneapolis, Minnesota, May 2016.

Mullen, C. J., "Chronic Care Management/Population Health in Rural Health Clinics," Presentation at Indiana Rural Health Association Spring into Quality, Plainfield, IN, March 2016.

Bartel, R., Bartel, D., Mullen, C. J., Kabcenell, K., "The Voice of the Caregiver is Part of the Solution," Presentation at Institute for Healthcare Improvement 27th Annual National Forum, Orlando, FL, December 2015.

Norwood, C., Mullen, C. J., Biviji-Sharma, R., Church, A., Henderson, M., Stone, C., "Policy Advocacy Actions at the Organization, State and National Levels: Using Service Learning to Inform Policy at the State Level," Presentation at American Public Health Association Annual Meeting, Chicago, IL, November, 2015.

Randoph, C., Maxey, H., Mullen, C. J., "A Comprehensive Evaluation Strategy: Clinical Health Coaches and Chronic Disease Management," Poster at American Public Health Association Annual Meeting, Chicago, IL, November, 2015.

Dodson, K., Cooper, M., Steuterman, E. C., Ginn, J., Mullen, C. J., Morris, S., Kevitt, M., "The Best of Indiana-Sharing our Successes," Presentation at The Arc National Convention, Indianapolis, IN, October 2015.

Bally, B., Felberbaum, C., Kelly, E., Knighton, S., Mullen, C. J., Thakkar, J., "Institute for Healthcare Improvement (IHI) Open School Change Agent Network (I-CAN):The Student Hub of 100MHL," Presentation and Poster at the Institute for Healthcare Improvement 100 Million Healthier Lives 1 Year Celebration, Washington D.C., September 2015.

Mullen, C. J., "Rural Healthcare Trends, Reform, and State Outlook," Presentation at USDA Public Private Partnership Multistage Meeting, Noblesville, IN, April 2015.

Mullen, C. J., Berenson, M. , "Critical Access Hospital Capacity for Patient Centered Care and Strong Specialty Care via Telemedicine," Presentation at the National Rural Health Policy Institute, Washington D.C., February 2015.

Chase, A., Haskall, H., Hayward, M., Mullen, C. J., "Storytelling: Harnessing the Power of Patient and Family Experiences," Presentation at 26th Annual Institute for Healthcare Improvement 26th Annual National Forum, Orlando, FL, December 2014.

Levey, M., Mullen, C. J., Busenbark, D., Hill, J., "A Solution for Rural Communities: Community Health Workers/Health Coaches," Presentation at Indiana Rural Health Association Fall Forum: Harvesting Rural Solutions, Plainfield, IN, October 2014.

Henderson, M. L., Mullen, C. J., Osborne, L., Church, A., Comer, A., Stone, C., "A Student Collaboration to Promote Health in Transit Policy Planning," Poster at New Dimensions in Urban Health and Action Conference, Indianapolis, IN, April 2014.

Henderson, M. L., Mullen, C. J., Osborne, L., Church, A., Comer, A., Stone, C., "Improving Public Health Action in Transit Legislation," Poster at 10th Annual Robert G. Civic and Community Engagement Bringle Showcase and Symposium, Indianapolis, IN, April 2014.

Dickerson, J., Mullen, C. J., Cooper, M., "Testimony from The Arc of Indiana & Self-Advocates of Indiana" Presentation to the Aged, Blind and Disabled Task Force Stakeholder Presentations, Indianapolis, IN, August, 2013.

Mullen, C. J., "Critical Access Hospitals and Acute Care Hospitals: Their Readmission Profile Differences," Presentation at Regenstrief Center for Healthcare Engineering Summer Research Conference, West Lafayette, IN, August 2012.

Mullen, C. J., Musselman, K. J., Zhiyi, T., "Care Coordination and Hospital System Readmission," Presentation at Institute of Industrial Engineers 2012 Annual Conference and Expo, Orlando, FL, May 2012.

Mullen, C. J., "Critical Access Hospitals: A Study of Readmissions," Presentation at Regenstrief Center for Healthcare Engineering Spring Research Briefs, West Lafayette, IN, April 2011.

Musselman, K. J., Mullen, C. J., Zhiyi, T., Witz, S. M., "Producing Preventable Readmissions: System Flow Analysis," Presentation at BayCare Health Readmission Workshop, Tampa, FL, November 2011.

Mullen, C. J., Lorca H. M., "Hospital Readmissions: A Systems and Disease Specific Approach," Presentation at Regenstrief Center for Healthcare Engineering Fall Research Briefs, West Lafayette, IN, November 2011.

Mullen, C. J., "Hospital Readmissions and the Cycle of Care," Presentation at Regenstrief Center for Healthcare Engineering Summer Intern Presentations, West Lafayette, IN, August 2011.

Mullen, C.J., "Center for Assistive Technology Vocational Rehabilitation Patient Flow Analysis," Poster at Discovery Park Undergraduate Intern Poster Open House, West Lafayette, IN, April 2010.

Mullen, C.J., "Center for Assistive Technology Vocational Rehabilitation Claims Data Analysis," Poster at Regenstrief Center for Healthcare Engineering Poster Competition, West Lafayette, IN, December 2009.

Mullen, C. J., "Center for Assistive Technology: Analysis of FSSA Administrative Assistive Technology Data," Presentation at Regenstrief Center for Healthcare Engineering Coffee and Collaboration, West Lafayette, IN, September 2009.

Mullen, C. J, "Center for Assistive Technology Vocational Rehabilitation Patient Flow," Poster at Discovery Park Undergraduate Intern Poster Open House, West Lafayette, IN, April 2009.

Publications

Mullen, C. J., (2018). "Indiana Rural Opioid Consortium Year 1 Evaluation," Indiana Rural Health Association.

Mullen, C. J., (2017). "Opioid Prescribing Challenges and Best Practices for Critical Access and Rural Hospitals Evaluation." Indiana State Department of Health.

Harle, C., Mullen, C., Vest, J., Menachemi, N. (2016). "Not just teachers: what do health administration faculty do all day?," Journal of Health Administration Education: Vol. 33(2), p 235-251.

Swanson-Kanzley, A., Delifraine, J., Lemak, C., Mullen, C., Menachemi, M. (2016). "Work-life balance among health administration faculty who are parents," Journal of Health Administration Education: Vol. 33(2), p 333-350.

Holmes, A., DelliFaine, J., Lemak, C., Mullen, C., Menachemi. M. (2016). "Health Administration Faculty: Intentions to retire, leave the profession, and change jobs," Journal of Health Administration Education: Vol. 33(2), p 253-270.

Laws, S., Southard, E. P., Mullen, C. J. (2016). "Evaluation of State of Indiana Emergency Management Services," Indiana Department of Homeland Security.

Southard, E. P., Mullen, C. J., Laws, S., Eberhardt, R. (2015). "The State of Mobile Integrated Health Care and Community Paramedicine in Indiana Project Activity Report," Indiana State Department of Health-State Office of Rural Health.

Mullen, C. J., Osburn, L. L. (2013). "Indiana Scheduled Prescription Electronic Collection & Tracking (INSPECT) Program Evaluation," Health Policy and Program Evaluation Course.

Mullen, C. J., Wilson G. (2013). "2013 Community Health Needs Assessment: Citizens Health Clinic Location," Eskenazi Health System.

Mullen, C. J. (2012). "Hospital System Readmissions: A Care Coordination Approach," Journal of Purdue Undergraduate Research: Vol. 2, p. 42-47.